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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

RAINFALL, GROUND-WATER FLOW, AND SEASONAL MOVEMENT AT MINOR CREEK LANDSLIDE, NORTHWESTERN CALIFORNIA: PHYSICAL INTERPRETATION OF EMPIRICAL RELATIONS,
Cascades Volcano Observatory, Vancouver, WA.
R. M. Iverson, and J. J. Major.
Geological Society of America Bulletin BUGMA, Vol. 99, No. 10, p 579-594, October 1987. 15 fig, 4 tab, 56 ref.

Descriptors: *Rainfall, *Groundwater movement, *Seasonal variation, *Landslides, *California, Minor Creek, Mathematical studies, Hydraulic gradient, Erosion, Surface flow.

Simple groundwater flow analyses can clarify complex empirical relations between rainfall and landslide motion. Detailed data are presented on rainfall, groundwater flow, and repetitive seasonal motion that occurred from 1982 to 1985 at Minor Creek landslide in northwestern California. These data are interpreted in the context of physically based theories, and indicate that landslide motion is closely regulated by the direction and magnitude of near-surface hydraulic gradients and by waves of pore pressure caused by intermittent rainfall. Diffusive propagation of pore-pressure waves accompanies downward groundwater flow along nearly vertical hydraulic gradients that exist in most of the landslide. Limit-equilibrium analysis shows that when seasonal pressure waves reach the landslide base, they establish a critical distribution of effective stress that delicately triggers landslide motion. The critical effective-stress balance is extremely sensitive to the direction and magnitude of hydraulic gradients. Although pervasively downward gradients instigate motion, it is inferred from theory and limited data that groundwater also may circulate locally in near-surface cells. The circulation can further reduce the landslide's frictional strength, particularly in areas of nearly horizontal groundwater flow that occur beneath steep faces of hummocks. Hummocky topography that results from slope instability may therefore cause groundwater flow that perpetuates instability. (Lantz-PTT)
W88-04530

SOIL LOSS AND RUNOFF FROM NATURAL VELD IN THE CENTRAL ORANGE FREE STATE (SEDIMENTVERLIES EN OPPERVLAKAFLOOP VANAF NATUURLIKE VELD IN DIE SENTRALE ORANJE-VRYSTAAT),
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Soil Science.
For primary bibliographic entry see Field 2J.
W88-04570

RAINFALL INTERCEPTION BY A YOUNG ACACIA AURICULIFORMIS (A. CUNN) PLANTATION FOREST IN WEST JAVA, INDONESIA: APPLICATION OF GASH'S ANALYTICAL MODEL,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
L. A. Bruijnzeel, and K. F. Wiersum.
Hydrological Processes HYPRE3, Vol. 1, No. 4, p 309-319, November 1987. 3 fig, 5 tab, 33 ref.

Descriptors: *Rainfall, *Interception, *Acacia trees, *Rainfall interception, *Tropical regions, *Forests, *Model studies, Java, Indonesia, Throughfall, Stem flow, Water loss, Evapotranspiration, Mathematical analysis.

Measurements are reported of rainfall, throughfall, stemflow, and derived interception losses made on a daily basis during two consecutive rainy seasons in a 4-5 year old and rapidly growing plantation forest of Acacia auriculiformis in a humid tropical environment. During the first observation period throughfall, stemflow, and interception loss amounted to 81, 8 and 11% respectively, of gross precipitation, while corresponding values for the second observation period were 75, 7 and 18%. All three components correlated strongly with amounts of daily rainfall, but slopes of linear regression equations differed significantly between seasons for each component. Such differences are thought to reflect a 20% increase in foliar mass as well as a certain instrumental bias introduced by the use of a fixed grid of throughfall troughs that differed between seasons. Tests did not reveal any effects of differences in rainfall characteristics although the two observation periods differed markedly in this respect. Although the present results fell within the (lower part of the) range reported for other sites in Southeast Asia application of Gash's analytical model suggested the results obtained during the second observation period to be anomalous. The model was tested with data from the second halves of the two observation periods, using parameters derived from the corresponding first halves. Discrepancies between estimated and observed losses were +9.4 and -14.3% for the two periods respectively. The bulk of the interception loss consisted of evaporation from a saturated canopy (69-80%) and of evaporation after rainfall had ceased (25 and 15% for the two periods respectively). Although the results were encouraging it would seem that a major difficulty in applying the analytical model to the humid tropics lies in obtaining a reliable estimate of the evaporation rate from a saturated canopy. (Author's abstract)
W88-04571

REGRESSION MODELS FOR HYDRAULIC CONDUCTIVITY AND FIELD TEST OF THE BOREHOLE PERMEAMETER,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2F.
W88-04601

TIME TO PONDING: COMPARISON OF ANALYTIC QUASI-ANALYTIC, AND APPROXIMATE PREDICTIONS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W88-04611

JOINT RANK TEST FOR ASSESSING MULTIVARIATE NORMALITY IN HYDROLOGIC DATA,
Northest Hydraulic Consultants, Inc., Kent, WA.
For primary bibliographic entry see Field 7C.
W88-04612

UPPER AND LOWER BOUNDS OF THE PONDING TIME FOR NEAR CONSTANT SURFACE FLUX,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2G.
W88-04628

DEVELOPMENT OF A COMPUTERIZED WATER BALANCE PROGRAM FOR THE EASTERN ARKANSAS REGION COMPREHENSIVE WATER SUPPLY STUDY,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 6D.
W88-04668

EFFECT OF THE 1986 DROUGHT ON STREAMFLOW IN SELECTED STREAMS IN MISSISSIPPI,
Mississippi Bureau of Land and Water Resources, Jackson.
For primary bibliographic entry see Field 2E.
W88-04674

DETERMINISTIC CATCHMENT MODELLING,
Lancaster Univ. (England). Dept. of Environmental Sciences.
T. O'Donnell.
IN: River Flow Modelling and Forecasting. D.Reidel Publishing Co., Dordrecht, Holland, 1986. p 11-37, 15 fig, 35 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Catchment modelling, *Runoff forecasting, Mathematical models, Mathematical studies, Catchment, Runoff.

Modelling of catchment behavior in the quantitative sense may be used to reconstruct past rainfall-to-runoff or to forecast future relationships of rainfall to runoff. Both physical models and analogue models should be based on mathematical descriptions of relevant processes, particularly in deterministic catchment modelling. The hydrograph of total streamflow from a catchment is the continuing response of that catchment to the history of precipitation and evaporation over the catchment. A simplified representation of catchment behavior embodies all the characteristics employed by systems engineers. Systems are defined as linear and non-linear; modelling techniques fall under the headings of analysis methods and synthesis methods, with examples given of various types, and equations given for determination of different models. General cautions are summarized to remind the reader that although many different models might be adjusted to fit a particular situation, there is as yet no technique for evaluating or devising optimum models. Optimization techniques have been developed that determine values of system parameters which maximize or minimize some function dependent on those parameters. Some of these techniques have been widely used in catchment modelling studies and allow the user, not as familiar with the model as is its creator, to concentrate on other aspects of the model study. (See also W88-04686) (Bicht-PTT)
W88-04687

LOW FLOW SUSTAINED BY GROUND WATER,
Hanover Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W88-04689

RELATIONSHIP BETWEEN THEORY AND PRACTICE OF REAL-TIME RIVER FLOW FORECASTING,
Ruhr Univ., Bochum (Germany, F.R.).
G. A. Schultz.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 181-193, 4 fig, 6 ref.

Descriptors: River flow, *Flow forecasting, *Model studies, *River forecasting, Mathematical studies, Mathematical analysis, Flood Routing, Meltwater runoff, Theoretical analysis.

The choice of adequate forecasting models depends on several features: accuracy and availability of data and instrumentation, qualification and training of staff, performance of data processing equipment and the consequences of over- and underestimation of forecast. It is impossible to give general rules and only possible to chose a combination of model elements tailored to the project conditions and purpose. The acquisition of relevant model input data is discussed, with attention to remote sensing techniques and the use of rainfall forecasts as a basis for flood forecasting. The role of the human factor in flow forecasting is also considered in an attempt to assimilate real-world experience with theoretical models. (See also W88-04686) (Bicht-PTT)
W88-04692

CASE STUDIES IN REAL-TIME HYDROLOGICAL FORECASTING FROM THE UK,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W88-04693

DESIGN AND OPERATION OF FORECASTING OPERATIONAL REAL-TIME HYDROLOGICAL SYSTEMS (FORTH),

World Meteorological Organization, Geneva (Switzerland).
J. Nemec.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 299-327, 3 fig, 2 tab, 14 ref, 2 append.

Descriptors: *Hydrological Systems, *Forecasting, *Flood forecasting, *River forecasting, Model studies, Mathematical models, Systems analysis, Computers, FORTH, Hydrologic models, Computer models, Indus River.

Hydrological forecasting is the prior estimate of future states of hydrological phenomena in real time. It comprises technical activities such as network design, data processing, hydrological analysis and synthesis, remote sensing techniques, telecommunications, operational use of computers, etc. It should not be viewed as one particular hydrological technique, but as an economic activity using many technological developments. The emphasis of flood forecasting has changed in recent times from structural measures of flood prevention and damage reduction to the development of flood control management, use of networks, reservoirs, etc. The relationships of meteorological and hydrological forecasts is considered in the creation of a FORTH (Forecasting Operational Real-Time Hydrological) System. A general description and outline is given of data needed both for the development of the System and its operation, and of the equipment and processing systems necessary to their utilization. The component sub-systems are listed in an Appendix. Classification of models for hydrological forecasting purposes is considered, although it should be understood that such classification is not necessarily identical to the classification of models in general. The selection of forecasting procedures is given attention, with recommendations on verification criteria and moisture accounting. Evaluation must be given to the methods of forecasting, the operation of the forecasting system and to the accuracy of the forecasts themselves; direction for such evaluation is offered. A discussion of the benefits and cost ratio of any system serves as a reminder that most case studies show an overwhelming margin of benefits over cost. Finally, an example of a FORTH system in operation at the Indus River Basin in Pakistan is outlined in a second Appendix. (See also W88-04686) (Bicht-PTT)
W88-04697

MULTIVARIATE STOCHASTIC FLOOD ANALYSIS USING ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and P. F. Krstanovic.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-234944/AS. Price codes: A04 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Completion Report, October 1986. 57 p, 13 fig, 1 tab, 35 ref, 4 append. Contract No. 14-08-0001-G1020. Project No. USGS G1020-06 (6).

Descriptors: *Flood frequency analysis, *Model studies, *Flood flows, *Entropy, *Stochastic hydrology, Distributions, Risk, Louisiana.

The principle of maximum entropy (POME) is used to perform a multivariate stochastic flood analysis. By specifying appropriate constraints in terms of means, variances, covariances and cross-covariances, various multivariate exponential distributions are derived. From these distributions, univariate, bivariate and general multivariate stochastic models are then derived. Both continuous and discrete cases are examined. Special emphasis is given to the structure of the matrix of Lagrange multipliers in the models. The bivariate stochastic model for flood peaks and volumes is investigated for two cases: (1) The peaks and volumes are independent and occur the same number of times. (2) The number of peaks is more than that of volumes in the same time interval. Testing on two Louisiana rivers show that case (1) is an approximation of case (2). Marginal frequency distributions of peaks, volumes and duration are obtained, first with no restrictions imposed, and then with assumptions of independent occurrences and a high threshold value. Conditional distributions of flood volumes, given peaks and of flood durations, given volumes and peaks are then presented. (Singh-LA WRRI)
W88-04760

DESIGN OF RAINFALL NETWORKS USING ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W88-04762

COMPARATIVE EVALUATION OF THE ESTIMATORS OF SOME FLOOD FREQUENCY MODELS USING MONTE CARLO SIMULATION,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and K. Arora.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-235735/AS. Price codes: A07 in paper copy, A01 in microfiche. Completion Report, February 1987. 124 p, 6 fig, 31 tab, 80 ref. Contract No. 14-08-0001-G1020. Project No. USGS G1020-06(3).

Descriptors: *Flood frequency, *Model studies, Estimators, Flood analysis, Quantile estimates, Parameter estimates, Maximum entropy, Direct moments, Indirect moments, Mixed moments, Maximum likelihood estimation, Method of entropy, Simulation analysis, Monte Carlo method.

Performance of estimators of several commonly used flood frequency models is evaluated in terms of the statistical criteria of bias (BIAS), standard error (SE), and mean square error (MSE). The procedure is based on Monte Carlo simulation. The models considered are the Gumbel's extreme value type 1 (EV1), log Pearson type 3 (LP3), and the two component extreme value (TCEV) distributions. The estimators used are based on the moments (MOM), maximum likelihood estimation (MLE), probability weighted moments (PWM), least squares (LEAS), incomplete means (CM), mixed moments (MIX), and entropy (ENT). The performance of the EV1 estimators is evaluated for random as well as serially correlated samples. MLE provides efficient quantile estimates even for small samples, closely followed by ENT. The PWM quantile estimates are unbiased for random samples and least biased for serially correlated samples. The performance of the estimators worsens for the serially correlated case, though they perform much more closely in this case. A new correction is derived, based on simulation results, to correct the bias in the MOM quantile estimates. The LP3 estimators are evaluated over the range of coefficients of variation and skewness characteristic of the real flood occurrence. The performance of the estimator recommended by the U.S. Water Resources Council, and other competing estimators is significantly inferior to that of MIX and another estimator based on the moments of the variate in real space. A new methodology is developed to solve for the MIX parameter estimates directly, without having to resort to an iterative procedure. (Singh-LA, WRRI)
W88-04763

CLARK UNIT HYDROGRAPH AND R-PARAMETER ESTIMATION,
G. V. Sabol.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 1, p 103-111, January 1988. 2 fig, 12 ref, append.

Descriptors: *Rainfall-runoff relationships, *Hydrologic models, *Hydrographs, *Streams, *Flood hydrographs, *Runoff, *Unit hydrographs, Storage coefficient, Unit hydrographs, Clark hydrograph, Storms, Synthetic hydrology, Watersheds, Model studies, Mathematical models, Surface water.

The Clark unit hydrograph, a three-parameter synthetic unit hydrograph procedure, can be used in flood hydrology and other surface water runoff studies that require the development of a hydrograph or the reconstitution of a flood event. The technique is particularly valuable for unusually shaped watersheds, such as watersheds with large length-to-width ratios, or for application to watersheds containing several different physiographic areas, such as plateaus, escarpments, and valleys. The Clark unit hydrograph can be developed completely by a mathematical routing procedure that is computationally very efficient and lends itself to convenient computer applications. Although this unit hydrograph procedure has a strong theoretical basis and is very applicable to many watersheds, it has not gained wide application. Infrequent use by practicing engineers may be because of the difficulty in evaluating the storage coefficient R from recorded hydrographs, and the lack of empirical procedures to estimate R for ungaged watersheds. A procedure was developed to facilitate the evaluation of R from recorded hydrographs using the technique of hydrograph recession analysis which eliminates some of the difficulties and uncertainties that are associated with the traditional method of evaluating R. The method was used in the performance of a flood study for a proposed dam in western Colorado. (Cassar-PTT)
W88-05079

PARAMETER ESTIMATION FOR LOG-PEARSON TYPE III DISTRIBUTION BY POME,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and K. Singh.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 1, p 112-122, January 1988. 2 fig, 3 tab, 24 ref, append.

Descriptors: *Rainfall-runoff relationships, *Hydrologic models, *Streams, *Flood forecasting, Log-Pearson distribution, Maximum likelihood estimation, Method of moments, Mathematical studies, Parametric hydrology, Rivers.

The principle of maximum entropy (POME) was employed to derive an alternative method of parameter estimation for the log-Pearson type III distribution. Historical flood data were used to evaluate this method and compare it with the method of moments (MOM) and maximum likelihood estimation (MLE). The three methods were applied to annual peak discharge data for six rivers: Amite River at Magnolia, LA; Sebasticook River at Pittsfield, ME; Oyster River at Durham, NH; Squannacook River at West Groton, MA; Parker River at Byfield, MA; and Hop river at Columbia, CT. The parameter estimates yielded by POME are comparable to those by MOM and MLE. For three of the six rivers, POME produced the least relative absolute error and relative mean error. (Cassar-PTT)
W88-05080

2B. Precipitation

COMPARISON OF EXTREME 1-DAY AMOUNTS OF RAINFALL FOR COASTAL AND NORTH CENTRAL CLIMATIC REGIONS OF MISSISSIPPI,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
K. C. McGregor, R. A. Muller, and C. E. Murphee.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 73-78, 4 fig, 6 tab, 7 ref.

Descriptors: *Rainfall, *Mississippi, *Climate zones, Rainfall rate, Seasonal variation, Comparison studies, Rainstorms, Precipitation.

One-day rainfall events of 3 or more occurred at least once within the North Central Climatic Region and twice each year in the Coastal Climatic Region of Mississippi during a 30-year period (1951-1980) at selected rainfall stations. Such an event had an average occurrence of about once every nine and six months, respectively, in the North Central and Coastal Climatic Regions. For the Coastal Climatic Region, the average number of excessive 1-day events (3 inches or more) per

station peaked in April (11 events) and September (9 events) during the 30-year period. On the average, a rainfall station within the Coastal Climatic Region had 1-day rainfall of at least 3 in in April and September every 2.7 and 3.3 years, respectively. Within the Coastal Climatic Region the number of events for interior and coastal stations were quite similar. In the North Central Climatic Region peaks occurred in March, April and November, when there was an average of 6, 5 and 5 events per station, respectively, during the 30-year period. These numbers represent a 1-day rainfall event per station of at least 3 inches in March, April and November every 5, 6 and 6 years, respectively. About 75% of excessive 1-day events were less than 4.8 and 4.1 inches in the Coastal and North Central Climatic Regions, respectively. The highest amounts per excessive event in the Coastal Climatic Region were 4.8 and 4.9 inches in September and October, respectively. Highest amounts per event in the North Central Climatic Region were 4.0, 4.0 and 4.2 inches during March, July and November, respectively. Annual rainfall averaged about 63 and 54 inches for the Coastal and North Central Climatic Regions, respectively. The highest rainfall (including non-excessive rainfall) in the Coastal Climatic Region was in the spring, mid-summer and early fall compared to only spring in the North Central Climatic Region. (See also W88-04665) (Lantz-PTT)
W88-04679

DESIGN OF RAINFALL NETWORKS USING ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W88-04762

2C. Snow, Ice, and Frost

FREEZING AND THAWING OF SOILS AND PERMAFROST CONTAINING UNFROZEN WATER OR BRINE,
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 2G.
W88-04608

FORECASTING MELTWATER RUNOFF FROM SNOW-COVERED AREAS AND FROM GLACIER BASINS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Physics.
H. Lang.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 99-127, 3 fig, 4 tab, 49 ref.

Descriptors: *Snowmelt, *Runoff forecasting, *Glacier basins, *Glacial streams, *Meltwater, Meltwater runoff, *Snowmelt, Catchment areas, Snowcover, Snow surveys, Heat budget, Heat transfer, Temperature effects, Regression analysis, Thermal retention, Capillarity.

Snow and glaciers make hydrology an interesting field for research and forecasting, implying as they do the storage of water, with many rivers and streams originating in mountainous regions showing an even distribution of flow from year to year and also for shorter time scales within the melt season. The problem of forecasting meltwater runoff from snowcovers and from glaciers requires that a variety of factors be considered, depending on the type of forecast and on the catchment. Such quantities as percentage of snow in precipitation, accumulation rates, areal distribution, thermal-physical properties, heat flux, and climatic parameters are discussed, with equations given for their estimation. Photographic and photogrammetric methods for determining areal snow are presented, along with a discussion of various methods of determining melt rates, not least of which is an examination of past records. Examples are given of long range and seasonal forecasting, with remarks on the selection of appropriate models, which are most effective only in the long term. (See also W88-04686) (Bicht-PTT)
W88-04690

ICE BARRIER FOR ISLANDS,
Atlantic Richfield Co., Los Angeles, CA.
L. V. Gefvert.
U. S. Patent No. 4,265, 569; May 5, 1981, 5 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1066, No 1, p 207, May 5, 1981.

Descriptors: *Breakwaters, *Ice control, *Patents, *Barriers, *Ice pressure, *Ice loads, *Islands, Floating ice, Pressure ice, Ice formation, Arctic.

An ice barrier alone or in combination with other barriers can be used on the periphery of an island to break up ice as it approaches the island and prevent the solid ice flow from impinging directly on the island. The barriers are closed, hollow, and triangular shaped. The hypotenuse side faces the ice and the first and second sides opposite the hypotenuse side rest on a support in the water body and about the island, respectively. The hypotenuse side is split into upper and lower sections with the upper section having a steeper angle of inclination than the lower section and containing a system for heating the hypotenuse side. (Cremmins-AEPCO)
W88-04783

ICE ISLAND CONSTRUCTION,
Standard Oil Co., Chicago, IL.
For primary bibliographic entry see Field 8A.
W88-04804

RESEARCH IN GLACIAL, GLACIO-FLUVIAL, AND GLACIO-LACUSTRINE SYSTEMS.
For primary bibliographic entry see Field 2J.
W88-05013

SUBGLACIAL PROCESSES AND THE DEVELOPMENT OF GLACIAL BEDFORMS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
G. S. Boulton.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 1-31, 13 fig, 33 ref.

Descriptors: *Glacial sediments, *Subglacial processes, *Sedimentation, Glacial drift, Glaciology, Glacial erosion, Ice levels, Geomorphology, Drumlins.

Studies beneath modern glaciers reveal three sets of glacial (sensu stricto) depositional processes: (a) falling of debris or debris-rich ice from the glacier onto the floors of subglacial cavities; (b) lodgement of debris in traction over the bed; and (c) deformation of subglacial sediments. All three processes have the capacity to develop stream-lined subglacial landforms. Process (a) may fill subglacial cavities on the lee of bedrock crags to produce streamlined 'tails'. Process (b) may produce streamlined drumlin forms as a result of differential lodgement as a glacier flows over obstacles on its bed. Process (c) may produce mobile drumlin forms around relatively slowly deforming nuclei in an inhomogeneous deforming sediment, or a static drumlin around a stationary obstacle, or a static residual drumlin where surrounding material has flowed away from a more resistant mass. Processes (b) and (c) in particular have a strong tendency to produce forms with typical drumlin asymmetry, a steep stoss side and a shallow lee side, while process (a) may help to produce rock-cored drumlins or crags and tails. All processes may be combined, and the probability that 'drumlins' are polygenetic requires that internal structures, in addition to surface forms, must be studied to understand their origin. Ice sheet models, one of an ancient ice sheet and one of West Greenland, are utilized to understand how sediment and landform production by ice sheets may vary spatially. It is concluded that the precise location of most forms is determined by the properties of the glacier bed, but that glacier variables play an important role in determining their larger scale distribution. Glacier properties are almost invariably conducive to production of these streamlined landforms in the marginal area, although under appropriate bed conditions they may be produced deep beneath the glacier. (See also W88-05013) (Author's abstract)
W88-05014

TILL HUMMOCK (PROTO-DRUMLIN) AT THE ICE GLACIER BED INTERFACE,
Brock Univ., St. Catharines (Ontario). Dept. of Geography.
J. Menzies.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 33-47, 5 fig, 29 ref. NSERC Grant No. A6900.

Descriptors: *Drumlins, *Hummock, *Glacial drift, Glaciology, Glacial erosion, Bedrock, Geologic formations, Mathematical studies, Shear stress, Ice load.

The initiation and subsequent development of drumlins is considered with regard to those drumlins lacking obvious rock or boulder cores, or bedrock knolls around which material has nucleated. The mechanics of glacial deposition to allow for localized points of agglomeration is discussed with reference to conditions in the subglacial environment. When sufficient glacial detritus has agglomerated at localized points at the ice/glacier bed interface, a state may be reached at which this agglomeration begins to act as an obstacle to the passage of the ice. It is at this point that the processes leading toward drumlin formation are initiated. Several mechanisms are suggested to account for the persistance of the material at the interface from which a till hummock (proto-drumlin) begins to be evolved. Marked geotechnical changes in the material occur such that the hummock persists and develops at the glacial interface. It is shown that, under specific ice velocities and thicknesses associated with varying detrital shear strengths, the size and growth of drumlins can be approximately predicted. Calculations reveal that drumlins will tend to form in zones close to and at some distance from the ice margin, with a less favored area existing between. (See also W88-05013) (Author's abstract)
W88-05015

FORMATION OF GLACIAL FLUTINGS IN EAST-CENTRAL ALBERTA,
Alberta Univ., Edmonton. Dept. of Geography.
N. Jones.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 49-70, 7 fig, 2 tab, 27 ref.

Descriptors: *Glacial fluting, *Glacial drift, *Alberta, *Geologic formations, Canada, Glacial sediments, Ice pressure, Glacial till, Geology, Drumlins.

The Lac la Biche fluting and drumlin field originates at Lac la Biche, Alberta, and extends southeast almost to North Battleford, Saskatchewan, a distance of approximately 390 km. The southeast orientation of the field is transverse to the regional northeast to southwest ice flow direction in Alberta. The Lac la Biche field appears to be a result of a late resurgence of the Wisconsin ice during deglaciation of this region, about 11,400 years ago. Field investigations, including till fabric, texture and lithology, showed ubiquitous glacial tectonic activity, implying that frozen-bed conditions and compressive ice flow probably ensued at some point during ice advance. The smooth, streamlined appearance of drumlins and flutings indicates a transgression into wet-bed conditions and, possibly, extending flow. Initial frozen-bed conditions and compressive flow caused glacial thrusting and plucking of blocks of basal debris near the margin of the ice. The blocks lodge at the glacier bed and resist further movement. With continued advance thawed-bed conditions are encountered and deposition in a low pressure zone created in the lee of these obstacles occurs. Lateral transport of debris in the lee of the blocks was accomplished as a result of the presence of converging secondary flow cells, created by the basal pressure gradient. Till fabric analyses show a 'herring-bone' fabric pattern, supporting the existence of converging

secondary flow. Auger holes drilled through three flutings, numerous road cut examination, and subsequent till textural and lithologic analyses, show only one till is present in the stream-lined landforms, reducing the validity of any hypothesis which involves the addition of two or more till layers during consecutive ice advances. The complete formation of both the drumlins and flutings occurred during a single ice advance. (See also W88-05013) (Author's abstract)
W88-05016

CONTEMPORARY PUSH MORAINE FORMATION IN THE YOHO VALLEY, BC,
Memorial Univ. of Newfoundland, St. John's.
R. J. Rogerson, and M. J. Batterson.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 71-90, 16 fig, 30 ref.

Descriptors: *Glacial drift, *Yoho Valley, *British Columbia, *Geologic formations, *Moraines, Canada, Rock glaciers, Rocks, Model studies, Emerald Glacier, Ridging, Sedimentation.

The characteristics and formation of minor push-moraine ridges are normally described for areas of terminal recession. Sometimes, ridge formation is described as an annual event. In the Yoho Valley (British Columbia, Canada) a multi-year contemporary push-moraine ridge is forming at the margin of Emerald Glacier. The glacier appears to be in a state of still-stand or minor readvance. Two models of push moraine formation are apparent: one where ice annually decouples from the moraine during the summer, then readvances with the cessation of ice melt in the early winter; and a second where the ice remains in contact with the moraine throughout the summer due to a thick supraglacial cover, which reduces ice melt. In the latter case, subglacially transported fines are intruded into or emplaced upon the loose-textured moraine ridge resulting in a complex sedimentary arrangement. The models are supported by two years of observation of the ice terminus, and by an intensive sediment sampling program. (See also W88-05013) (Author's abstract)
W88-05017

SUBGLACIAL FLUVIAL EROSION: A MAJOR SOURCE OF STRATIFIED DRIFT, MALASPINA GLACIER, ALASKA,
Texas Univ. at Austin. Bureau of Economic Geology.
T. C. Gustavson, and J. C. Boothroyd.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 93-116, 9 fig, 1 tab, 32 ref. Office of Naval Research Contract No. N00014-67-A-0230-0001.

Descriptors: *Glacial erosion, *Glacial drift, *Malaspina Glacier, *Alaska, Sedimentation, Fluvial erosion, Proglacial lakes, Glacial streams, Snowmelt, Glaciology, Glacial tunnels, Sediment transport, Geohydrology, Water pressure, Artesian flow.

Studies of the sedimentary processes and hydrology of meltwater streams and proglacial lakes along the margin of the Malaspina Glacier suggest that most stratified drift is derived primarily from subglacial fluvial erosion and transport of basal till remote from the ice margin. Major outwash fans, kame deltas, and proglacial lakes originate at ice marginal fountains or meltwater tunnels. Meltwater from the Malaspina drainage area (2,680 sq km) is discharged mostly via englacial and subglacial tunnels, and is derived from precipitation of 320 cm/annum and ablation of over 393 cm/annum. That meltwater in glacial tunnels far from the ice margin erodes and transports basal till is indicated by: (1) direct observation; (2) high suspended sediment content (3.4 to 4.7 g/l); and (3) massive amounts of outwash supplied to ice-marginal fans. The longevity of fountains also suggests that networks of englacial and subglacial tunnels are relatively stable. Discharge into Malaspina Lake from meltwater tunnels is as much as 460 cu m/sec and has occurred both at the base of the ice and part way up the ice contact face. Sediment is carried into the lake via continuous density flows issuing from the tunnel mouths. Hydrology of the glacier system is reflected by water levels in sinkholes that mark a potentiometric surface in the stagnant portions of the ice. Water within the higher or upglacier areas provides sufficient hydraulic head to maintain artesian conditions at the glacier margin, and to move sediment entrained at the base of the glacier through glacial tunnels. Artesian springs or fountains are maintained as ice retreats, as outwash plains aggrade, or as lake levels change. (Author's abstract)
W88-05018

DEPOSITIONAL PROCESSES IN THE DEVELOPMENT OF ESKERS IN MANITOBA,
Manitoba Dept. of Energy and Mines, Winnipeg. Mineral Resources Div.
S. Ringrose.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 117-137, 8 fig, 1 tab, 23 ref.

Descriptors: *Eskers, *Sediment transport, *Glacial drift, *Manitoba, Canada, Bedforms, Ridging, Sedimentation, Snowmelt, Glacial sediments, Ice drift, Bed load.

In an attempt to arrive at a comprehensive theory for the origin of eskers, different eskers occurring in northern, central and southern Manitoba are compared in terms of morphology and sedimentology. Northern eskers, which occur as continuous ridges in subparallel swarms are longer, higher, and narrower than southern eskers which occur relatively infrequently, in beads which are shorter, lower and wider. Nineteen major facies types are identified and interpreted relative to the current literature on closed conduit and open channel bedform types. This, used in conjunction with vertical, lateral and downstream facies relationships, provides evidence to suggest that the northern eskers are produced primarily by surges of sediment deposited in heterogeneous suspension in a closed tunnel, whereas central and southern eskers (where observed) are the products of braided stream, open channel environments. The different types may be related to the prevailing ice regime with southern, beaded eskers being formed initially in the relatively narrow ablation zone at the margin of a 'polar' ice sheet, which may have become inactive during the later (observed) stage of esker deposition. The northern Leaf Rapids esker is thought to have been formed under active ice during more temperate conditions, where rapid melt and ice movement cause sliding bed conditions in vertical tunnels. (Author's abstract)
W88-05019

BED FORM DIAGRAMS AND THE INTERPRETATION OF ESKERS,
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Geography.
H. C. Saunderson.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 139-150, 6 fig, 22 ref.

Descriptors: Data interpretation, *Glacial drift, *Glacial erosion, *Sedimentation, *Eskers, *Glaciohydrology, Snowmelt, Flow patterns, Glacial streams, Sediment transport, Glacial sediments, Bed load, Pipe flow.

Bedform stability diagrams offer considerable potential as an aid in the interpretation of glaciofluvial structures preserved in eskers. Structures of open channel and subglacial, free-surface flows are easier to interpret because of the abundance of experimental data available. Competency diagrams and stability diagrams may be used to obtain estimates of paleovelocity and paleodepth, from which other hydraulic parameters may be extrapolated. Although structures of sub-glacial, full-pipe flows are less well documented, some assistance to interpretation is forthcoming from pipe flow stability diagrams. Of particular note is the absence of antidunes from full pipe flows: recent experiments indicate that antidunes are replaced by a plane bed in sands where a bed is already in existence. Experiments by others show the presence of a sliding bed mode of transport between a plane bed and total suspension of sediment. (See also W88-05013) (Author's abstract)
W88-05020

HYDRAULIC GEOMETRY OF THE LOWER PORTION OF THE SUNWAPTA RIVER VALLEY TRAIN, JASPER NATIONAL PARK, ALBERTA,
Amoco Canada Petroleum Co. Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 2E.
W88-05021

DERIVATION OF A SUMMARY FACIES SEQUENCE BASED ON MARKOV CHAIN ANALYSIS OF THE CALEDON OUTWASH: A PLEISTOCENE BRAIDED GLACIAL FLUVIAL DEPOSIT,
Ontario Geological Survey, Toronto.
J. Z. Fraser.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 175-199, 9 fig, 5 tab, 43 ref.

Descriptors: *Glaciers, *Sedimentation, *Markov process, *Glacial drift, *Braided streams, *Outwash, *Facies, Glacial sediments, Glacial streams, Flow patterns, Pleistocene epoch.

The Caledon Outwash is a Late Pleistocene, ice-marginal glaciofluvial sequence in southern Ontario. The assemblage comprises eight distinct facies, and three coarse-grained facies predominate. The Gm (miall terminology) facies consist of horizontally stratified clast-supported gravel with well developed imbricate fabric. Coarse-grained Gp and Gt facies are characterized by planar and through cross-stratification respectively, and are the deposits of high flow stage, transverse primary bedforms. Fine-grained facies reflect the migration of dunes and sand waves at moderate flow stage and consist of trough (St), or less frequently, planar (Sp) cross-stratified sand and horizontally stratified sand (Sh). Ripple laminated sand (Sr) and silt (Fl) facies reflect deposition by low water accretion processes, and are uncommon in the depositional sequence. Markov chain analysis was employed to detect and enhance non-random facies transitions in the deposit. The derived summary sequence is dominated by superposed, truncated, upward fining and thinning sequences which represent repeated channel-fill events. The base of the summary sequence is defined by the initiation of a channel-fill cycle, often marked by the scour of large-scale Gt facies sets into underlying, finer grained facies of a previous cycle. The channel-fill sediments are predominantly multistorey sequences of Gm facies which represent aggradation by a successive longitudinal bars. Occasional solitary Gp and Gt facies sets in these sequences represent slight decreases in flow stage. The upper portions of channel-fill cycles are marked by aggradation of sand-dominant facies (St, Sp, Sh) and by general upward fining to low water accretion deposits (Sr and Fl facies). The fine-grained upper portions of the sequences are often partially removed by scour at the initiation of the next channel-fill cycle. (See also W88-05013) (Author's abstract)
W88-05022

COMPARISON OF SEDIMENTATION REGIMES IN FOUR GLACIER-FED LAKES OF WESTERN ALBERTA,
Illinois Univ. at Chicago Circle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W88-05023

GLACIO-LACUSTRINE SEDIMENTATION ON LOW SLOPE PROGRADING DELTA,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2J.

W88-05025

COARSE GRAINED FACIES OF GLACIO-MARINE DEPOSITS NEAR OTTAWA, CANADA,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
R. J. Cheel, and B. R. Rust.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 279-295, 9 fig, 22 ref.

Descriptors: *Facies, *Glacial drift, *Glacial sediments, *Snowmelt, *Sedimentation, *Ottawa, Champlain Sea, Canada, Outwash, Glacial streams, Erosion, Ice drift, Ridging, Boulders, Rocks, Marine sediments, Particle size, Quaternary period.

Some Late Quaternary sand and gravel ridges near Ottawa are believed to have formed by coalescence of subaqueous outwash fans deposited where glacial meltwater conduits emerged from the Wisconsin ice front beneath the Champlain Sea. The ridges are approximately parallel to the direction if ice transport, and developed as the ice front retreated northward. Exposures in the ridges have allowed a detailed investigation of coarse-grained glacio-marine deposits in relation to changing ice front morphology. Clast-supported cobble to boulder gravel was deposited on the fan apex, near the mouth of the conduit. Clast long axes are oriented either normal or parallel to the flow direction, depending on current velocity and clast size. Downfan from the gravel, cross-stratified sand accumulated, occasionally interbedded with flow till. These deposits are cut by steep-sided sand-filled channels that were eroded into the fan surface by cold, dense, sediment-laden currents issuing from the conduit. Soft-sediment deformation structures are common in silty fine sand on distal parts of the fan. They are preserved as thick units filling gravitational slumps, and above buried blocks of ice. All the above facies ideally are present in subaqueous outwash deposits, although variations are known, and are attributed to confinement of the depositional site within inlets of the glacier front. Variations include: (1) lower incidence of cross-stratified sand due to extensive reworking by channel migration within the inlet; (2) absence of mudsized sediments, transported beyond the inlet; and (3) intense deformation in response to the melting of ice walls and buried glacial ice. (See also W88-05013) (Author's abstract)
W88-05026

NEARSHORE DEPOSITS OF THE CHAMPLAIN SEA, NEAR OTTAWA, CANADA,
Reading Univ. (England). Dept. of Geography.
M. Hayward, and H. M. French.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 297-315, 10 fig, 2 tab, 24 ref. NSERC Grant No. A-8367.

Descriptors: *Glacial drift, *Glacial sediments, *Sedimentation, *Champlain Sea, *Ottawa, Canada, Marine sediments, Ridging, Ice drift, Snowmelt, Glacial streams, Boulders, Rocks.

The study of sections exposed in the Twin Elm and Herbert Corners commercial workings south of Ottawa permits the identification and classification of marine sediments derived from ridges of glaciogenic deposits. The ridges formed during the retreat of Wisconsin ice and contemporaneously with the early stages of the Champlain Sea or a lacustrine predecessor. Subsequently, a progressively falling wave base resulted in their reworking. Deposition occurred either within kettle depressions, formed through the melt of buried ice bodies, or as sand sheets on ridge flanks. In addition, lag deposits, derived from the reworking of the ridge materials, in places rest uncomfortably upon earlier marine deposits. Boulder beaches and beach ridges are associated with these littoral deposits. (See also W88-05013) (Author's abstract)
W88-05027

SNOW DISTRIBUTION ON FOREST CLEARCUTS IN THE SWEDISH MOUNTAINS,
Stockholm Univ. (Sweden). Dept. of Physical Geogrpahy.
K. A. Zakrisson.
Nordic Hydrology NOHYBB, Vol 18, No. 3, p 185-192, 1987. 4 fig, 1 tab, 3 ref.

Descriptors: *Snow accumulation, *Snow depth, *Snow, *Snow surveys, *Sweden, Monitoring, Accumulation, Surveys, Snowmelt, Snow-water equivalents, Forests, Field tests, Snow cover.

The problem of choosing localities at the margin of forests for snow surveys was addressed. A systematic study was made of differences in snow depth and water equivalents of snow accumulation near the boundaries between forests and open land. Field data were collected during the winter seasons 1983-84 and 1984-85. Snow depths were sounded and water equivalents were calculated for snow cover from profiles crossing distinct boundaries between forests and clearcuts. Snow accumulations were found to be relatively large in a zone up to 40 m just outside the forest boundary. Accumulations up to 15 m just inside the forest boundary were relatively small when compared to the forest in general. A slight excess of snow in the forest compared to the clearcuts, established at the beginning of the snow accumulation season, gradually turned into a small deficit in April. During most of the melting season, the amount of snow in forests is considerably greater than in the clearcuts. (Author's abstract)
W88-05047

CONE PENETRATION TESTING IN SNOW,
L. H. J. Schaap, and P. M. B. Fohn.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 3, p 335-341, August 1987. 10 fig, 1 tab, 11 ref.

Descriptors: *Snow, *Measuring instruments, *Snowpack, *Penetrometers, Ram penetrometers, Cone penetrometers, Avalanches, Slope stability.

The application of the electric cone penetrometer test in snow has been investigated and compared with results from the ram penetrometer test, which is normally used for snow profiling and slope stability analysis. A special cone penetrometer system was built consisting of a sensitive 1 sq cm electric cone, depth transducer, and battery-operated chart recorder. The instruments were tested in April 1985 at three different locations in the Swiss Alps and the test results were compared with those of the ram penetrometer tests. The tests yielded repeatable results up to a depth of 4 m with a high resolution of different snow layers. The electric cone tests show more layers than found in the ram profile and snow pit analyses. In soft snow the ram resistances appear to be, on average, about 30% lower than cone resistance values. It is recommended that the reliability and portability of the instruments be improved by providing better speed control and by incorporating a temperature sensor. (Cassar-PTT)
W88-05053

ADFREEZING STRENGTH OF ICE TO MODEL PILES,
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
V. R. Parameswaran.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 3, p 446-452, August 1987. 6 fig, 2 tab, 3 ref.

Descriptors: *Ice, *Materials engineering, *Freezing, *Piles, Adfreezing strength, Coatings, Asphalt, Silicones.

Adfreeze strength of freshwater ice to piles made of wood, steel, and aluminum, with and without coatings, was measured using model piles. Adfreeze strength increased with increase in the rate of displacement and loading of the pile. Creosote coating on wood piles reduced adfreeze strength at lower displacement rates, but had little effect at higher rates of loading. Adfreezing strength was reduced by a factor of 4 to 6 by bituminous roofing on wood piles; by a factor of 10 to 100 by silicone coating on aluminum piles. Peak adfreeze strengths (in MPa) were as follows: creosote on fir, 0.394-1.698; enamel paint on steel cylinder, 0.405-0.948; enamel paint on steel H-section, 0.368-0.517; uncoated aluminum cylinder, 0.614-0.788; silicone coating on aluminum cylinder, 0.005-0.037; uncoated aluminum H-section, 0.269-0.294; silicone coating on aluminum H-section, 0.002-0.014; asphalt on wood, 0.138-0.521; asphalt and gravel on wood, 0.252-0.491; Derbygum on wood, 0.378-0.614; uncoated tropical hardwood of four varieties, 0.768-1.780. (Cassar-PTT)
W88-05057

2D. Evaporation and Transpiration

USE OF EVAPORIMETERS FOR ESTIMATING MAXIMUM TOTAL EVAPORATION,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Agrometeorology.
For primary bibliographic entry see Field 7B.
W88-04568

RAINFALL INTERCEPTION BY A YOUNG ACACIA AURICULIFORMIS (A. CUNN) PLANTATION FOREST IN WEST JAVA, INDONESIA: APPLICATION OF GASH'S ANALYTICAL MODEL,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2A.
W88-04571

SOIL HEAT AND WATER FLOW WITH A PARTIAL SURFACE MULCH,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W88-04598

2E. Streamflow and Runoff

FLOOD FORECASTING: DANES UPDATE DAMODAR SYSTEM,
Danish Inst. of Applied Hydraulics, Hoersholm.
J. C. Refsgaard, and V. G. Ghanekar.
Water Resources Journal, No. 153, p 55-57, June 1987. 4 fig.

Descriptors: *Flood forecasting, *Damodar system, *Hydrologic models, *India, Mathematical models, Computer models, NAM, SYSTEM 11, Model studies, Flood plain management.

Attempts at real-time flood forecasting by the Indian government's Central Water Commission (CWC) have been based on manual data collection, wireless data communication (VHF) and forecast formulation, usually by graphic correlation methods. Though these methods are generally considered to have provided useful results, CWC has decided to incorporate recent advances in computer technology and mathematical modelling in its warning system on the Damodar. A model was established at Maithon, a reservoir on the Barakar, a left (or north) bank tributary of the Damodar. The catchment upstream of the Durgapur Barrage has been divided into 13 sub-catchments with separate rainfall and evaporation input in the rainfall-runoff (NAM) modelling. Hydraulic river routing (SYSTEM 11) has been worked out from the Tilaiya, Konar and Tenughat reservoirs - upstream of the bigger Maithon and Panchet reservoirs - down to the Durgapur Barrage. A total of 84 grid points were used to model this 470 km section of the river. The outflows from the NAM model are taken as inflow to SYSTEM 11. There are usually one hour time steps in the modelling. SYSTEM 11 has been used to evaluate the effects of various alternative schemes for improvement of the flood situation in the Lower Damodar. Among them: excavation of the main river, or of other river reaches; or the embankment of the main river and construction of short-cut channels between two river systems. The ultimate objective is to create a model which can be used in flood-prone areas throughout India. The NAM/S11 system is in-

stalled on CWC's HP1000 computer in Delhi and is being applied for real-time forecasting and flood control studies in the Yamuna River upstream of Delhi. (Lantz-PTT)
W88-04520

COLONIZATION OF WOOD SUBSTRATES BY THE AQUATIC XYLOPHAGE XYLOTOPUS PAR (DIPTERA: CHIRONOMIDAE) AND A DESCRIPTION OF ITS LIFE HISTORY,
Central Michigan Univ., Mount Pleasant. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-04541

FLOOD SIMULATION IN THE TIDAL DELTA OF THE MEKONG RIVER BY THE SSARR MODEL,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2L.
W88-04553

EXAMINATION OF THE EFFICIENCY OF A SIMPLE RUNOFF PLOT SAMPLE SPLITTER,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W88-04569

SOME PROBLEMS WITH THE MUSKINGUM METHOD,
Yangtze Valley Planning Office, Wuhan (China).
B. Luo, and X. Qian.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 4, p 485-496, December 1987. 1 fig, 2 tab, 9 ref.

Descriptors: *Flood routing, *Muskingum method, *Hydrologic models, Flood discharge, Flood hydrographs, Mathematical models, Mathematical equations, Flood routing, Unit hydrographs.

The Muskingum flood routing method is widely used by hydrologists and good results are frequently achieved. The method is based on the assumption of a linear relationship between the inflow to and the outflow from a river reach and the reach storage. However, there is still some dispute about the reliability of the Muskingum method. In this study the integration solution of the Muskingum method for multiple river reaches is derived. The relationship between the Muskingum method and the lag and route method for multiple reaches is discussed on the basis of the linear theory of hydrological systems, and the issue of initial negative outflows with the Muskingum method is explored. The study shows that the Muskingum method is an approximate solution of the instantaneous unit hydrograph of the lag and route flood routing method. (Lantz-PTT)
W88-04593

DERIVATION OF THE EXTREME VALUE (EV) TYPE III DISTRIBUTION FOR LOW FLOWS USING ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 4, p 521-533, December 1987. 2 fig, 2 tab, 15 ref, append.

Descriptors: *Entropy, *Mathematical analysis, *Low flow, River flow, Mathematical equations, Frequency analysis, Mathematical studies, Maximum likelihood estimation.

The extreme value type III distribution was derived by using the principle of maximum entropy for the frequency analysis of low river flows. The derivation required only two constraints to be determined from data, and yielded a procedure for estimation of distribution parameters. The following conclusions were drawn from this study: (1) The principle of maximum entropy provided an alternative method for estimating parameters of the extreme value type III distribution used in frequency analysis of low flows and droughts; (2) The parameter estimates yielded by the principle of maximum entropy were comparable to those yielded by the methods of moments and maximum likelihood estimation; and (3) The principle of maximum entropy uniquely specified the amount of information in terms of constraints required to derive the extreme value type III distribution. (Lantz-PTT)
W88-04595

HYDROLOGIC SIMILARITY. 2. A SCALED MODEL OF STORM RUNOFF PRODUCTION,
Princeton Univ., NJ. Dept. of Civil Engineering.
M. Sivapalan, K. Beven, and E. F. Wood.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2266-2278, December 1987. 10 fig, 23 ref. NASA Grant No. NAG-5-491 and Dept. of Interior (Geological Survey) Grant No. 14-08-0001-G1138.

Descriptors: *Hydrologic models, *Rainfall-runoff relationships, *Storms, *Runoff, Model studies, Mathematical models, Soil properties, Infiltration.

A simple, physically based conceptual model of runoff production based on catchment topography and the spatial variability of rainfall and soil properties considers both infiltration excess (Horton type) and saturation excess (Dunne type) runoff production mechanisms. The effect of topography is modeled using the ln (alpha/tan beta)-topographic index method of Beven and Kirkby. The effects of the spatial variability of soil properties and rainfall on areal average infiltration rates are handled using a quasi-analytical approach. The interaction between the two mechanisms of runoff production and the effect of a finite water table on the infiltration excess mechanism are explicitly considered. The model equations are cast in a dimensionless form to clarify the interrelationships involved in hydrological responses and to identify measures of similarity between different heterogeneous catchments. The dimensionless formulation has led to the identification of five similarity parameters and three dimensionless variables representing initial conditions and storm characteristics. A number of experiments were performed to study the sensitivity of the runoff production response to some of these similarity parameters. (Author's abstract)
W88-04607

QUANTIFYING SURFACE WATER SUPPLIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 7C.
W88-04669

EFFECT OF THE 1986 DROUGHT ON STREAMFLOW IN SELECTED STREAMS IN MISSISSIPPI,
Mississippi Bureau of Land and Water Resources, Jackson.
L. G. Long, and C. E. Clevenger.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 37-40, 4 fig, 1 tab, 10 ref.

Descriptors: *Water use, *Drought, *Streamflow, *Mississippi, Rainfall-runoff relationships, Water supply, Competing use, Groundwater storage, Groundwater recession, Surface water, Instream flow, Channel flow, Floods, Groundwater level.

The deficit rainfall experienced in 1986, particularly during the period January through April, had a great effect on the magnitude of low-flow yields from shallow groundwater storage in the state of Mississippi. This effect was evident in some areas in the fall of 1986 when flows went below the established in minimum flow, 7-day Q10. In areas where the geologic formations restrict groundwater movement, it may be a year or more before the full effect is evident. Knowledge of the low-flow characteristics of streams in Mississippi should be useful in developing potential solutions to water problems in the state. In this paper the effects of drought on streamflow are analyzed by comparins 1986 mean stream discharges with mean stream discharged for the period of record at Bogue Chitto near Tylertown, Town Creek in Tupelo, and Big Sunflower River at Sunflower, Mississippi. Since surface water is so widely used in the Mississippi Delta, a comprehensive in-depth analysis is vitally needed in that area of the state to forecast the effects that future groundwater levels may have upon the stream systems. If present trends are allowed to continue, many streams in the Delta may not have sufficient base flow to support fish and other wildlife resources; therefore, alternate means of sustaining flows must be found. (See also W88-04665) (Lantz-PTT)
W88-04674

METHODOLOGY OF MODELING SEDIMENT TRANSPORT IN WATER RESOURCES SYSTEMS,
Mississippi Univ., University. Center for Computational Hydroscience and Engineering.
For primary bibliographic entry see Field 2J.
W88-04675

ALTERNATIVE BASIN CHARACTERISTIC FOR ESTIMATING IMPERVIOUS AREA AND URBAN FLOOD FREQUENCY AND ITS POTENTIAL APPLICATION IN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W88-04678

RIVER FLOW MODELLING AND FORECASTING.
D. Reidel Publishing Co., Dordrecht, Holland, 1986. 372 p. Edited by D. A. Kraijenhoff and J. R. Moll.

Descriptors: *River flow, *River forecasting, *Groundwater movement, *Flood forecasting, Hydrologic Systems, *Hydrological forecasting, Snowmelt, Groundwater, *Model studies, Mathematical models, Glacial melt, Numerical analysis, Systems analysis, Flood routing.

Advances in computer technology, in the technology of communication and in mathematical modelling processes in the hydrological cycle have recently improved our ability to protect ourselves against damage though floods and droughts and to control quantities and qualities of our water systems. River flow forecasts are needed for various purposes within the framework of river basin management activities. Methods for producing forecasts are usually developed in the theoretical environment with an inevitable gap between theory and practice. An attempt is made in this book to narrow this gap and to minimize the time delay between development and implementation of such new techniques as may be useful for the solution of particular problems, with a discussion of possible discrepancies between the needs of the practitioner and the products of theory. Discussion is given to the objectives of forecasting and the criteria for successful forecasts, as well as to the underlying principles of modelling and flow forecasting for a variety of situations - flooding, glacial melt, groundwater flow - including the design and operation of real-time hydrological systems. The special problem of the system input, in forecasting terms, is the need for accurate hydrological data, with transmission of information to the forecasting center made as early as possible. This means that special data collection and transmission systems are required and it is obvious that in real-time flood forecasting it is usually not the model but the quality of the input data which forms the weakest link. Other problems are the organization, handling and processing of data in the forecasting center, and the dissemination of the computer flow forecast. Advice is given in the theoretical studies on the selection of adequate models and techniques, as well as in the presentation of specific case studies, with some discussion of the relationship between the theoretical models and the actual practical problems. (See W88-04687 thru W88-04698) (Bicht-PTT)
W88-04686

DETERMINISTIC CATCHMENT MODELLING,
Lancaster Univ. (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2A.
W88-04687

THEORY OF FLOOD ROUTING,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
J. C. I. Dodge.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 39-65, 7 fig, 24 ref.

Descriptors: *Flood routing, *Unsteady flow, Flood control, Theoretical studies, Mathematical studies, Mathematical analysis, Hydrological studies, Groundwater movement, Hydrologic models.

Equations are given for the analysis of unsteady flow in an open channel to take account of various characteristics of continuity and momentum, and accommodate differences of boundary conditions, both temporal and terminal. The question of appropriate boundary conditions is discussed in terms of characteristic paths, in the cases of tranquil and rapid flow, as well as linear equations and a simplification of St Venant equations. These basic equations for the solution of channel routing problems comprise a system of non-linear partial differential equations, which cannot be solved analytically but must be solved numerically. The system used to do so is the finite difference method, with discussion and a comparison of a variety of finite difference schemes, both implicit and explicit. Hydrologic models, both linear and non-linear, are also compared following an outline of a wide variety of hydraulic methods of channel routing and a description of hydrologic methods. (See also W88-04686) (Bicht-PTT)
W88-04688

FORECASTING MELTWATER RUNOFF FROM SNOW-COVERED AREAS AND FROM GLACIER BASINS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Physics.
For primary bibliographic entry see Field 2C.
W88-04690

RELATIONSHIP BETWEEN THEORY AND PRACTICE OF REAL-TIME RIVER FLOW FORECASTING,
Ruhr Univ., Bochum (Germany, F.R.).
For primary bibliographic entry see Field 2A.
W88-04692

RIVER FLOW SIMULATION,
Waterloopkundig Lab. te Delft, Emmeloord (Netherlands). De Voorst Lab.
J. G. Grijsen.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 241-272, 24 fig, 15 ref.

Descriptors: *Mathematical models, *Model studies, *River flow, *Finite difference methods, *Simulation, Numerical analysis, Mathematical studies, River forecasting, Networks, Boundary conditions, Mathematical equations, Mathematical analysis, Numerical properties.

River flow simulation by mathematical modelling requires an adequate quantitative mathematical description of the physical processes involved. This description often comprises a system of ordinary or partial differential equations, together with suitable boundary conditions. Equations for fluid flow are frequently so complicated that they can be solved only by computers. The equations usually include empirical factors associated with turbulence. Although more facilities are rapidly becoming available, numerical three-dimensional, time dependent calculations will not be feasible for most practical purposes. Solving two-dimensional time dependent problems is within the capabilities of existing computers; one dimensional calculations are more easily performed and satisfactory for many purposes. Finite difference methods for river flow simulation are considered including an examination of the underlying concept for this method and the numerical properties of various types of finite difference schemes. A specific scheme as used at the Delft Hydraulics Laboratory is detailed as well as an exploration of boundary conditions and special flow problems. A brief account is given of a specific case study of flood control for the rivers Parana and in Paraguay. (See also W88-04686) (Bicht-PTT)
W88-04694

FORECASTING AND WARNING SYSTEM OF THE 'RIJKSWATERSTAAT' FOR THE RIVER RHINE,
Rijkswaterstaat, The Hague (Netherlands).
J. G. de Ronde.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 273-286, 6 fig, 1 tab, 2 ref.

Descriptors: *Flood forecasting, *Rhine River, Flood control, Dikes, Low flow forecasting, Hydrologic models.

The seas and rivers would flood the largest part of the Netherlands if it were not protected by hundreds of kilometers of dikes, all of which must be carefully maintained and monitored. Good warning systems giving accurate and timely forecasts are important. The government agency 'Rijkswaterstaat' operates five different warning systems: (1) storm surge warning service; (2) river flood warning service; (3) daily river information service; (4) ice information service; and (5) information service on water supply. The empirical and statistical models applied are outlined. Forecasts of low flow are of economic interest and for this reason, a method was developed to subdivide the Rhine flow at Lobith into a component of (1) direct runoff and (2) base flow. The model consists of an unspecified detention storage that transforms the hyetograph of effective precipitation into a hydrograph of runoff. (See also W88-04686) (Bicht-PTT)
W88-04695

SHORT RANGE FLOOD FORECASTING ON THE RIVER RHINE,
Waterloopkundig Lab. te Delft, Emmeloord (Netherlands). De Voorst Lab.
J. R. Moll.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 287-297, 7 fig, 2 tab, 10 ref.

Descriptors: *Flow forecasting, *Flood forecasting, *Rhine River, Hydrological models, Stochastic models, River forecasting, Runoff forecasting.

A real-time flow forecasting model, as applied to the floods of the Rhine River in 1970, was based on extending a deterministic hydrological flood-routing model with a stochastic component, thereby describing the information contained in the forecast errors of the model. Flood forecasting is emphasized, but forecasting of low flows can also be accomplished using the same method. Critera for evaluating forecasting procedures are: (1) minimum variance of forecast errors; (2) no autocorrelation in forecast errors; (3) minimization of maximum errors; and (4) minimum error in peak timing. A deterministic hydrological model is set out with correlation of data, including errors. The model was based on continuous water level recordings at eight stations along the Rhine and average daily discharge values at five stations on the main tributary rivers during January 1 to March 31, 1970. Model performance was evaluated for the section Wesel-Lobith. The forecast quality was most sensitive to the updating of the forecast function. In the case of the Rhine, forecast lead time can be extended by including river sections upstream of Wesel. For extending lead times, tributary flows and forecasting tributary flows become more important. (See also W88-04686) (Bicht-PTT)
W88-04696

CASE STUDIES ON REAL-TIME RIVER FLOW FORECASTING,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
G. Fleming.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 329-366, 30 fig, 4 tab, 13 ref.

Descriptors: *Streamflow forecasting, *River forecasting, *Santa Ynez River, *California, *Derwent River, *England, *Orchy River, *Scotland, Hydrologic systems, Hydrologic forecasting, Flood forecasting, Systems analysis, Case studies, Flow profiles, River basin development, Forecasting, Drought, River flow.

Three case studies give examples of flood peak forecasting, drought sequence forecasting, and forecasting for river basin development, following a step-by-step progression from definition of problem; review of data sources; definition of assessment priorities and selection of model; assemblage of data base; calibration of model; verification of model representation; application of model and resolution of original problem. The three cases are: Santa Ynez river in California (flood peak forecasting), Derwent river in England (drought sequence forecasting), and Orchy river in Scotland (forecasting for development). Each of the cases is discussed in great detail, serving developmentally as a quantitative exploration of the processes involved in the establishment and operation of river flow forecasting. (See also W88-04686) (Bicht-PTT)
W88-04698

STREAMFLOW AND VELOCITY AS DETERMINANTS OF AQUATIC INSECT DISTRIBUTION AND BENTHIC COMMUNITY STRUCTURE IN ILLINOIS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04699

EFFECTS OF GEOLOGY, RUNOFF, AND LAND USE ON THE STABILITY OF THE WEST GALLATIN RIVER SYSTEM, GALLATIN COUNTY, MONTANA,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
D. R. Reichmuth.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB84-228162. Price codes: A05 in paper copy, A01 in microfiche. Research Project Technical Completion Report, June 1983. 71 p, 40 fig, 7 tab, 4 append. Department of Interior Contract No. 14-34-0001-1128, Project No. A-088-MONT.

Descriptors: *West Gallatin River, *Runoff, *Montana, *Land use, River flow, Alluvial plains, Geology, Drainage system, Irrigation, Forest management, Earthquake, Isostatic shifting, Geomorphology.

The West Gallatin River flows northward from its headwaters in Yellowstone Park. For the first fifty miles the river is confined in the narrow, rugged Gallatin Canyon. The river then enters the Gallatin Valley which is a broad, relatively flat alluvial valley. This study analyzes the behavior of the West Gallatin River in this lower section. It was found that the river has been changed considerably by geologically recent tectonic events such as earthquakes and isostatic shifting of large portions of the drainage area. During the past 100 years man has been actively altering elements of the drainage system. These alterations include forest management, irrigation, road construction, and housing development. Unfortunately many of these activities have been disruptive and have caused additional instabilities to develop in the system. This study describes both the natural and man induced changes which have occurred in terms of their system effect. It is hoped that a better understanding of the river's system behavior will lead to less adverse impacts when future activity in the drainage is undertaken. (Author's abstract)
W88-04700

INCREASING THE ECONOMIC EFFICIENCY AND AFFORDABILITY OF STORM DRAINAGE PROJECTS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
For primary bibliographic entry see Field 6A.
W88-04708

PMF (PROBABLE MAXIMUM FLOOD) STUDY FOR NEVADA NUCLEAR WASTE STORAGE INVESTIGATION PROJECT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
K. L. Bullard.
Available from the National Technical Information Service, Springfield, VA. 22161, DE87-012940. Price codes: no paper copy, A01 in microfiche. Report No. GR-87-8, January 1986. 593 p, 42 tab, 44 plates, 10 ref. USGS Contract No. DE-A108-78ET44802.

Descriptors: *Probable maximum flood, *Probable maximum precipitation, *Floods, *Radioactive wastes, *Nevada Nuclear Waste Storage, *Data collections, Yucca Mountains, Runoff, Storm runoff, Management planning.

One of the sites being considered for a deep geologic repository is Yucca Mountain in southern Nevada. To design the central surface facility for the project, consideration must be given to the effects of runoff of rainfall from local storms. Probable maximum precipitation is determined using the National Weather Service's Hydrometeorological Report 49. This data is given here in tabular form. This precipitation is used in conjunction with surface topography to determine floods at desired sites. A check of the values determined in the analysis is made using USGS streamflow data. Recommendations of floods are made for use in planning studies. (Author's abstract)
W88-04725

MULTIVARIATE STOCHASTIC FLOOD ANALYSIS USING ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-04760

COMPARATIVE EVALUATION OF THE ESTIMATORS OF SOME FLOOD FREQUENCY MODELS USING MONTE CARLO SIMULATION,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-04763

EFFECTS OF LAKES AND WETLANDS ON FLOODFLOWS AND BASE FLOWS IN SELECTED NORTHERN AND EASTERN STATES,
Geological Survey, Ithaca, NY.
For primary bibliographic entry see Field 2H.
W88-04947

HYDRAULIC GEOMETRY OF THE LOWER PORTION OF THE SUNWAPTA RIVER VALLEY TRAIN, JASPER NATIONAL PARK, ALBERTA,
Amoco Canada Petroleum Co. Ltd., Calgary (Alberta).
R. J. Rice.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 151-173, 10 fig, 1 tab, 6 ref.

Descriptors: *Sunwapta River, *Jasper National Park, *Alberta, *Braided streams, *Channel flow, *Channel morphology, *Hydraulic geometry, *Glaciohydrology, Hydraulic properties, Channel width, Channel depth, Flow rates, Outwash.

Morphologic and hydraulic data were gathered from 60 gravel channels (20/reach) on the Beauty Creek Flats section of the proglacial Sunwapta River during August 4-15, 1977. Four power functions (log-linear: width, average depth, average surface velocity and water surface slope) are determined for each reach and for Beauty Creek Flats as a whole with discharge as the independent parameter in all cases. A downstream hydraulic geometry interpretation indicates that the downstream reduction in the media grain size is mainly responsible for the variation in channel behavior. In all three reaches of Beauty Creek Flats the primary adjustment of the channels to an increased discharge is an increase in the width of the flow. It appears that the width exponent may be used as an index of braiding intensity. On Beauty Creek Flats, slope is an independent parameter and is not a significant influence in the nature of the anabranch adjustment. The hydraulic geometry relations determined for Beauty Creek Flats as a whole are compared to corresponding relations from other gravelly, glaciofluvial environments. The comparison suggests that Arctic and non-Arctic outwash may be distinguished by the magnitude of the width and velocity exponents. The former is lower in an Arctic environment while the latter is higher. This suggests that there may be a similarity in channel response among areas of braided gravel outwash provided associated climatic conditions are similar. If additional data on channel adjustment on areas of gravelly outwash supports a similarity there may be potential for the development of a set of hydraulic geometry equations for each environment which could be used as predictors of channel behavior. (See also W88-05013) (Author's abstract)
W88-05021

DERIVATION OF A SUMMARY FACIES SEQUENCE BASED ON MARKOV CHAIN ANALYSIS OF THE CALEDON OUTWASH: A PLEISTOCENE BRAIDED GLACIAL FLUVIAL DEPOSIT,
Ontario Geological Survey, Toronto.
For primary bibliographic entry see Field 2C.
W88-05022

SIMULATION OF SURFACE RUNOFF AND PIPE DISCHARGE FROM AN AGRICULTURAL SOIL IN NORTHERN SWEDEN,
Sveriges Lantbruksuniversitet, Uppsala.
For primary bibliographic entry see Field 2G.
W88-05045

ABUNDANCE AND DISTRIBUTION OF LEGIONELLACEAE IN PUERTO RICAN WATERS,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W88-05062

TURBULENCE MEASUREMENTS IN SMOOTH AND ROUGH-WALLED TRAPEZOIDAL DUCTS,
Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 8B.
W88-05075

COMMON BEHAVIORAL TRENDS IN ALLUVIAL CANALS AND RIVERS,
For primary bibliographic entry see Field 2J.
W88-05076

UNCERTAINTY IN SUSPENDED SEDIMENT TRANSPORT CURVES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W88-05077

CLARK UNIT HYDROGRAPH AND R-PARAMETER ESTIMATION,
For primary bibliographic entry see Field 2A.
W88-05079

PARAMETER ESTIMATION FOR LOG-PEARSON TYPE III DISTRIBUTION BY POME,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-05080

EXPERIMENTAL STUDIES OF PHYSICAL FACTORS AFFECTING SESTON TRANSPORT IN STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. R. Webster, E. F. Benfield, S. W. Golladay, B. H. Hill, and L. E. Hornick.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 848-863, July 1987. 9 fig, 4 tab, 55 ref. NSF Grants DEP 78-03012, DEB 81-03181 and DOE Contract DE-AC05-840R21400.

Descriptors: *Seston, *Roughness, *Storms, *Streamflow, *Sediment transport, Simulated rainfall, Aquatic drift, Artificial watercourses, Model studies.

Three series of experiments were conducted in laboratory and natural streams to evaluate effects of various physical factors on particulate organic matter retention, entrainment, and transport. Laboratory experiments showed that substrate characteristics were important in determining retention of all sizes of seston. Retention increased with roughness and substrate complexity. During simulated storms in laboratory streams, seston concentrations were not generally correlated with discharge. A strong correlation was found, however, between seston concentration and the rate of increase in discharge during rising hydrographs. After peak discharge, seston concentration dropped exponentially independent of discharge. Simulated storms conducted in a natural stream channel supported these findings. Results of these experiments and published field studies suggest that existing sediment transport models have little application to seston transport in small streams, primarily because of limited availability of seston. (Author's abstract)
W88-05104

2F. Groundwater

HYDROGEOLOGY OF AN ALKALINE FLY ASH LANDFILL IN EASTERN IOWA,
Illinois State Water Survey Div., Champaign. Meteorology Section.
For primary bibliographic entry see Field 5B.
W88-04485

PARAMETRIC MODELING OF THE UPPER RIO COBRE BASIN,
Dames and Moore, Riyadh (Saudi Arabia).
M. O. Walters.
Ground Water GRWAAR, Vol. 25, No. 5, p 527-534, September-October 1987. 5 fig, 1 tab, 9 ref.

Descriptors: *Model studies, *Upper Rio Cobre basin, *Jamaica, *Groundwater movement, *Karst, Hydrographs, Surface runoff, Hydrologic models, Aquifers, Groundwater level, Mathematical models, Unit hydrographs.

Similarity of groundwater hydrographs in karst aquifers with surface runoff hydrographs indicates that some models used in unit hydrograph analysis could adequately model the groundwater system. Two such models are used to model groundwater levels in a karst aquifer. The aquifer was treated as a linear time-invariant system with a response function representing the rise in groundwater levels in response to rainfall. Two discrete parametric models, the Nash and Muskingum, were tested as response functions. Parameters for both models were identified from one year of data by applying the theory of moments to sets of input and output data. The models were verified using rainfall and water-level data for a second year. The Muskingum method did not adequately model the system. Results of the Nash model were good. (Author's abstract)
W88-04486

WATER MOVEMENT IN TILL OF EAST-CENTRAL SOUTH DAKOTA,
Illinois State Water Survey Div., Champaign.
S. J. Cravens, and L. C. Ruedisili.
Ground Water GRWAAR, Vol. 25, No. 5, p 555-561, September-October 1987. 8 fig, 1 tab, 20 ref.

Descriptors: *Glacial aquifers, *Groundwater movement, *Tills, *South Dakota, Permeability coefficient, Hydrography, Evapotranspiration, Subsurface drainage.

Results from the first phase of a study on water movement within the till of east-central South Dakota indicate that little to no water passes from the weathered till through the underlying outwash deposits. Based on hydrographic analyses, field hydraulic conductivity measurements, and major-ion sampling at 22 sites, discharge from the weathered till is hypothesized to be primarily from evapotranspirative losses during periods of high water table. Hydraulic conductivity of the unweathered till is typically 10 to 200 times lower than the weathered till. Water sampled from the unweathered till is up to three times higher in major-ion concentrations than water in underlying outwash deposits. Carbon-age dates of water from the buried outwash deposits suggest an age in excess of 9,000 years before the present, corresponding to the Late Wisconsinan glacial epoch. (Author's abstract)
W88-04489

MONITORING MOISTURE MIGRATION IN THE VADOSE ZONE WITH RESISTIVITY,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
W. F. Kean, M. J. Waller, and H. R. Layson.
Ground Water GRWAAR, Vol. 25, No. 5, p 562-571, September-October 1987. 14 fig, 3 tab, 10 ref.
US Bureau of Mines Contract no. HO 245004.

Descriptors: *Electrical studies, *Geophysical studies, *Geophysics, *Groundwater movement, *Vadose water, *Soil water, *Resistivity, Tensiometry, Unsaturated flow, Aeration zone, Gravity groundwater.

Studies of moisture migration in the vadose zone were conducted at four field sites using a reverse Schlumberger resistivity array. Gravimetric moisture measurements on soil samples taken at each of the field sites were made to a maximum depth of 1.83 m, and these results were correlated with resistivity values. Tensiometer measurements were also taken at two of the four sites. The soils at the sites have combined clay and silt content (less than .0625 mm grain size) which varies from 13% to 84%. Three of the sites are underlain by sand or gravel in the unsaturated zone. The fourth site has fractured but relatively impermeable shales and siltstones under the surface soils. Depths to water table varied from 1.58 m to 13.7 m. Resistivity and gravimetric moisture measurements were carried out prior to the addition of water to the surface, and following the application of water, either by watering of the site (at two sites) or during and after rainfall events (at two sites). Monitoring was carried out for periods of one to three weeks. Results indicate that: (1) moisture is retained for long periods of time in clay/silt-rich soils; (2) moisture migration is slow below a moist soil zone and is not readily detected by surface resistivity measurements; and (3) near-surface moisture changes can be defined by surface resistivity. (Author's abstract)
W88-04490

REPRESENTATIVE SAMPLING OF GROUND WATER FROM SHORT-SCREENED BOREHOLES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 7B.
W88-04492

PUMPTEST.BAS: A PROGRAM TO CALCULATE TRANSMISSIVITY AND STORATIVITY,
Nebraska State Dept. of Environmental Control, Lincoln.
S. M. Smith.
Ground Water GRWAAR, Vol. 25, No. 5, p 599-602, September-October 1987. 1 fig, 2 ref, append.

Descriptors: *Aquifers, *Computer programs, *Storativity, *Pumping tests, *Transmissivity, Mathematical analysis, Confined aquifers, Hydrologic models, Drawdown.

PUMPTEST.BAS is a program for calculating transmissivity and storativity in confined aquifers using the graphical method of Cooper and Jacob for evaluating the results of a pumping test. It is written in Microsoft GW-BASIC for the IBM PC and compatibles using 640 X 200 pixel monochrome graphics mode. It was originally conceived as an aid in the teaching of introductory and intermediate hydrology and thus assumes fairly ideal conditions, i.e. a fully screened pumping well in a horizontal, nonleaky aquifer. The program is self-prompting and will provide instructions for its use if requested. Transmissivity and storativity are calculated according to the equations: T = 2.3Q/4piH and S = 2.25T (t sub o)/r-squared, where T is the transmissivity, Q is the pumping rate, H is the change in drawdown in the observation well over an elapsed time of one order of magnitude (the semilogarithmic slope), S is storativity, t sub o is the time at the x-intercept of the line, and r is the distance from the pumped well to the observation well. (Lantz-PTT)
W88-04494

QUALITY GROUNDWATER FOR TOMORROW,
Miljoestyrelsen, Copenhagen (Denmark).
For primary bibliographic entry see Field 5G.
W88-04513

IMPROVED BOREHOLE SITING SUCCESS USING INTEGRATED GEOPHYSICAL TECHNIQUES,
Hydrotechnica, Shrewsbury (England).
For primary bibliographic entry see Field 7A.
W88-04515

DRILLING AND CONSTRUCTING MONITORING WELLS WITH HOLLOW-STEM AUGERS. PART 1: DRILLING CONSIDERATIONS,
Bennett and Williams, Inc., Columbus, OH.
For primary bibliographic entry see Field 8A.
W88-04546

VOLATILIZATION LOSSES OF ORGANICS DURING GROUND WATER SAMPLING FROM LOW PERMEABILITY MATERIALS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5A.
W88-04547

IN SITU MULTILEVEL SAMPLER FOR PREVENTIVE MONITORING AND STUDY OF HYDROCHEMICAL PROFILES IN AQUIFERS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 5A.
W88-04548

SOURCES OF GROUND WATER SALINIZATION IN PARTS OF WEST TEXAS,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 5B.
W88-04549

MINIMIZING INTERPRETATION AMBIGUITIES THROUGH JOINT INVERSION OF SURFACE ELECTRICAL DATA,
Geophysics Group, San Diego, CA.
For primary bibliographic entry see Field 7B.
W88-04552

STUDY OF THE THREE-DIMENSIONAL GROUNDWATER FLOW SYSTEM IN AN UPLAND AREA OF JAPAN,
Tsukuba Univ. (Japan). Inst. of Geoscience.
S. K. Bae, and I. Kayane.
Hydrological Processes HYPRE3, Vol. 1, No. 4, p 339-358, November 1987. 13 fig, 2 tab, 40 ref. Ministry of Education, Science and Culture, Japan, Grant-in-Aid for Scientific Research Nos: 5903009 and 60030010.

Descriptors: *Groundwater movement, *Tracers, *Japan, *Flow profiles, Simulation, Finite difference methods, Mathematical models, Tritium, Flow patterns, Hydrologic models, Discharge, Recharge, Kasumigaura Lake, Pumping, Irrigation, Precipitation.

A three-dimensional finite difference model was developed to study the groundwater system in an upland area bordering Kasumigaura Lake. For a general perspective of the groundwater flow system, a steady state three-dimensional flow was employed. Having determined the flow net by using a three-dimensional model, the flow volumes under natural conditions was used to establish the parameter values and for the analyses of flow patterns. Further, to study the effects of human impact and precipitation on groundwater flow conditions in a small area, a transient three-dimensional simulation was performed. Environmental tritium was used to trace the regional groundwater movement to verify the three-dimensional mathematical model. Results obtained using the three-dimensional mathematical model approach and tritium concentration analyses were in close agreement and demonstrated that the groundwater flow system should be analyzed using a three-dimensional geometric concept of groundwater movement. The results are summarized as follows: (1) the dissected valleys in the upland area are important foci of drainage, and the small dissected valleys also play an important role in the drainage system; (2) there is no groundwater flow across the two main rivers and little groundwater can cross the small dissected valleys; (3) groundwater is recharged in the upland area and is primarily discharged to the valley, river, or lowland; (4) the groundwater flow system in this area is composed primarily of local and some intermediate flow systems; (5) groundwater flow adjacent to the river or alley flank is relatively fast; (6) the variation of the groundwater flow system is mostly influenced by human impact rather than by natural conditions; (7) regardless of the rate of withdrawal, the groundwater flow pattern gradually reaches a quasi-steady state from the transient conditions after 10 days; (8) groundwater table fluctuations occur continuously over time in this area due to the effects of pumping, irrigation, and precipitation; and (9) water discharging to the lake originates mainly from the upland located adjacent to the lake. (Lantz-PTT)
W88-04573

ISOTOPIC INVESTIGATION OF SOIL WATER MOVEMENT: A CASE STUDY IN THE THAR DESERT, WESTERN RAJASTHAN,
Physical Research Lab., Ahmedabad (India).
For primary bibliographic entry see Field 2G.
W88-04592

SOIL WATER MOVEMENT ESTIMATED FROM ISOTOPE TRACERS,
Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 2G.
W88-04594

MODEL FOR HYSTERETIC CONSTITUTIVE RELATIONS GOVERNING MULTIPHASE FLOW. 1. SATURATION-PRESSURE RELATIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 2G.
W88-04599

MODEL FOR HYSTERETIC CONSTITUTIVE RELATIONS GOVERNING MULTIPHASE FLOW. 2. PERMEABILITY-SATURATION RELATIONS,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 2G.
W88-04600

REGRESSION MODELS FOR HYDRAULIC CONDUCTIVITY AND FIELD TEST OF THE BOREHOLE PERMEAMETER,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, K. Lambert, and D. Watson.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2207-2214, December 1987. 4 fig, 4 tab, 32 ref. New Mexico WRRI Project No. 1423648.

Descriptors: *Regression analysis, *Mathematical models, *Permeability coefficient, *Groundwater movement, *Permeameters, *Boreholes, Groundwater recharge, Vadose water, Sediments, Seepage, Flow rates, Mathematical studies, Simulation.

The saturated hydraulic conductivity K sub s of sediments in the vadose zone is an important parameter in predicting the seepage rates of water and contaminants. The borehole permeameter is an in situ technique to test a relatively large sample size at any depth. Solutions are presented which account for the effects of unsaturated flow. These solutions are derived from a regression analysis of results of numerical simulations in which unsaturated hydraulic conductivity is represented by one or two parameters. The results of a borehole permeameter test in a uniform sand are compared with field ponding tests and air entry permeameter tests. The regression-based solutions for the borehole permeameter which account for capillarity provide very good agreement with other permeameter results. Depending upon the approach used to solve the borehole problem K sub s values determined by methods which neglected and included capillary effects varied by a factor of only about two for the soil tested. (Author's abstract)
W88-04601

GROUNDWATER GEOCHEMISTRY OF AQUIFER THERMAL ENERGY STORAGE: LONG-TERM TEST CYCLE,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2K.
W88-04602

INFILTRATION JOINING PROBLEM,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W88-04604

LONG-TERM POLLUTANT DEGRADATION IN THE UNSATURATED ZONE WITH STOCHASTIC RAINFALL INFILTRATION,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04605

HEAT TRANSFER IN AQUIFERS WITH FINITE CAPROCK THICKNESS DURING A THERMAL INJECTION PROCESS,
Volkseigener Betrieb Kombinat Erdoel-Erdgas, Gommern (German D.R.).
H. D. Voight, and F. Haefner.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2286-2292, December 1987. 6 fig, 2 tab, 11 ref.

Descriptors: *Confined aquifers, *Heat transfer, *Geothermal studies, *Energy storage, *Injection wells, *Mathematical models, *Thermal injection, *Caprock, Model studies, Groundwater, Water temperature, Seasonal variation.

A two-dimensional model has been developed to solve for the problem of thermal injection into confining aquifer with a caprock of finite thickness and a bedrock of infinite thickness. Heat transfer by horizontal convection within the aquifer and by vertical conduction in the caprock and bedrock is considered. The model also incorporates variable temperatures on the surface of the caprock. Thus it can be used to study problems in connection with aquifer thermal energy storage, heat recovery from, and cold water injection into aquifers near the surface. This study concludes that: (1) The temperature in an aquifer during thermal injection/recovery can be calculated with sufficient accuracy by analytical solutions developed for describing heat transport in a formation consisting of several shallow porous strata; (2) The seasonal surface temperature changes can be estimated by superposition of the derived solutions. Thus problems of geothermal energy production, as well as of heat storage in aquifers with a caprock thickness range of 10 m can be calculated; (3) The influence of the finite caprock thickness on the aquifer temperature in the direct vicinity of the injection well is negligibly small, but it grows with distance from the well and becomes dominant at a great distance; and (4) The influence of horizontal heat conduction within the aquifer on the steady state temperature in the aquifer may be neglected. (Lantz-PTT)
W88-04609

SAMPLE VOLUME EFFECTS ON SOLUTE TRANSPORT PREDICTIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5B.
W88-04610

PROCEEDINGS OF THE SEVENTEENTH MISSISSIPPI RESOURCES CONFERENCE.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 6B.
W88-04665

EFFECT OF THE 1986 DROUGHT ON THE MISSISSIPPI RIVER ALLUVIAL AQUIFER,
Mississippi Bureau of Land and Water Resources, Jackson.
J. R. Spencer, and K. S. Ehret.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 23-26, 6 fig, 1 tab, 3 ref.

Descriptors: *Drought, *Mississippi River aquifer, *Aquifers, *Groundwater level, *Groundwater management, *Groundwater recession, Rainfall-runoff relationships, Groundwater recharge, Water use, Potentiometric level.

Underlying the 7,000 sq mi alluvial plain in northwestern Mississippi commonly known as the 'the Delta', is a shallow, highly productive groundwater-bearing unit, the Mississippi River alluvial aquifer. In 1980, about three-fourths of the total groundwater withdrawn in the State, chiefly for agriculture and aquaculture, was from this 80 ft to 180 ft of sand and gravel. The water-level declines experienced in the Delta over the past 10 years were greatly intensified by the record-setting drought during 1985-86. The drought conditions experienced in the winter and spring months combined with the tremendous demand placed on the aquifer for irrigation and aquaculture water resulted in the greatest yearly decline observed to date. The above average groundwater declines observed in the Mississippi River alluvial aquifer during April, 1986 in the Delta were due to the lack of precipitation and subsequent runoff. Groundwater levels near streams were affected most. This is because these areas lie in an aquifer recharge zone and possibly because of base-flow recharge. Further studies would be required to define precise areas of groundwater and surface water interaction. Since the major source of recharge for the Mississippi River alluvial aquifer is the Mississippi River, no long term effects due to the drought are anticipated. Water-level measurements made in the Delta during September, 1986, indicated no appreciable change in water level declines over previous years. However, this study has shown that during drought years, water levels are rapidly affected. The lack of recharge to the aquifer from the Mississippi River and runoff from the Bluff Hills resulted in a dramatic lowering of the alluvial aquifer potentiometric surface. During these periods of temporary shortage, it may be necessary to further regulate groundwater use in affected areas. For this reason, a complete updated inventory of the alluvial aquifer is necessary for the formulation of sound water-managing policies within the Delta area to protect this vital and important natural resource. (See also W88-04665) (Lantz-PTT)
W88-04671

EFFECT OF THE 1986 DROUGHT ON STREAMFLOW IN SELECTED STREAMS IN MISSISSIPPI,
Mississippi Bureau of Land and Water Resources, Jackson.
For primary bibliographic entry see Field 2E.
W88-04674

MIOCENE GROUNDWATER OVERDRAFT IN SOUTHERN MISSISSIPPI,
Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 4B.
W88-04681

APPLICATION OF A LAYERED GROUNDWATER MODEL TO CRITICAL AREAS IN NORTHEAST MISSISSIPPI,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W88-04682

INDICATIONS OF DOWNWARD LEAKAGE FROM THE WATER-TABLE AQUIFERS TO THE PRINCIPAL ARTESIAN AQUIFER AT MEMPHIS, TENNESSEE,
Geological Survey, Memphis, TN. Water Resources Div.
W. S. Parks.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 95-97, 6 fig, 1 ref.

Descriptors: *Leaky aquifers, *Groundwater movement, *Memphis, *Tennessee, Water table, Groundwater level, Flow profiles, Vertical flow, Isotope studies, Groundwater management, Pumping, Soil properties, Confined aquifers.

Downward vertical leakage from the water table aquifers to the Memphis Sand is occurring in the Memphis urban area. This vertical leakage occurs by downward movement of water from the water table aquifers through the Jackson-upper Claiborne confining unit into the Memphis Sand, or where the confining unit is absent, directly into the Memphis Sand. The downward vertical leakage probably has been greatest in areas where the Jackson-upper Claiborne confining unit is thin or absent and in Memphis Light, Gas and Water Division well fields, where this leakage has been induced by pumping stress in the Memphis Sand. The southern part of Sheahan well field is an area where much information indicates that vertical leakage occurs from the water table aquifers to the Memphis Sand. This information includes: (1) an adjacent area where the confining unit is thin or absent and contains little or no clay, (2) head differences generally favoring the downward movement of water, (3) a distortion in the geothermal gradient with the coolest temperature at a depth of about 230 feet, (4) a depression in the water table surface and long-term water level declines in the water table aquifer (fluvial deposits), and (5) carbon and hydrogen isotope data that indicate the presence of relatively recent water in the Memphis Sand. (See also W88-04665) (Lantz-PTT)
W88-04683

SIMULATION OF THE FLOW SYSTEM IN THE SHALLOW AQUIFER, DAUPHIN ISLAND, ALABAMA,
Geological Survey, Tuscaloosa, AL.
R. E. Kidd, and W. S. Mooty.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Missis-

sippi. 1987. p 99-100, 2 fig, 6 ref.

Descriptors: *Simulation analysis, *Flow profiles, *Aquifers, *Groundwater movement, *Alabama, *Dauphin Island, *Model studies, Geohydrology, Groundwater level, Hydrologic models, Water level, Wells, Pumping, Saline water intrusion.

Dauphin Island is underlain by more than 23,000 ft of Coastal Plain sediments ranging in age from Jurassic to Holocene. This investigation is limited to the sediments with potential as freshwater aquifers. Only the uppermost water-bearing zone consists of the surficial aquifer, which is a thin veneer of Holocene sand that covers most of the surface. This aquifer is recharged by rainfall, and loses water by seepage to surface water, evapotranspiration, and pumpage. A two-dimensional finite-difference model of the water table aquifer was used to evaluate the flow system. The model parameters used were: aquifer hydraulic conductivity, aquifer thickness, recharge to the aquifer, and the vertical hydraulic connection between the aquifer and the surrounding surface water bodies. The performance criteria for the steady-state model are that the computed groundwater levels match, with reasonable closeness, the corresponding measured groundwater levels. Fifty-six percent (9 of 16) of the model calculated water levels were within 0.50 ft of the measured water levels. All computed water levels were within 1 foot of measured water levels. Pumpage schemes with eight wells pumping a total of 0.3 Mgal/d (200 gpm) and 0.6 Mgal/d (400 gpm) were simulated with both steady-state and transient models. Steady-state simulation of pumping at 0.3 Mgal/d produced water levels of about 1 to 2 ft above sea level at each of the eight wells. Increasing pumpage to 0.6 Mgal/d produced water levels of about 2 to 3 ft below sea level at each well. Transient model simulation of 0.3 Mgal/d pumpage created water levels of 1 to 2 ft above sea level. Pumpage of 0.6 Mgal/d created water levels from about 2-1/2 to near 4 ft below sea level. The simulated pumping schemes indicate the water table aquifer could yield 0.6 Mgal/d without lateral encroachment with recharge less than the 10-year average minimum. All of the schemes maintained a groundwater divide between the wells and the surrounding salt-water bodies. (See also W88-04665) (Lantz-PTT)
W88-04684

SALINE WATER OCCURRENCE WITHIN THE TERTIARY SPARTA SAND AND COCKFIELD AQUIFERS OF WASHINGTON COUNTY, MISSISSIPPI,
Mississippi Bureau of Land and Water Resources, Jackson.
D. J. Bockelmann.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 101-107, 8 fig, 22 ref.

Descriptors: *Saline water intrusion, *Aquifers, *Mississippi, *Groundwater quality, Sodium, Chlorides, Dissolved solids, Salt water, Salinity, Well logs, Resistivity.

The Cockfield and Sparta Sand aquifers are formations of the Claiborne Group and are Tertiary in age. Both aquifers are widely utilized as sources for domestic and municipal drinking water. General water quality from the two aquifers is considered good throughout most of the county. However, higher than normal chloride and dissolved solids concentration levels have been noted at various areas within the county. Geographic areas with abnormally high saline concentrations are dictated by a combination of discontinuous sand beds, regional trend and dip patterns and local structural features. These higher than normal saline areas can be defined using concentration (isocon) mapping techniques. At least four wells have shown an increase in chloride concentration levels with time; one of these wells is located in southern Greenville while the other three wells are located just south of Greenville, near Swiftwater. Dissolved solids and chloride concentration levels within individual sand zones of the Cockfield and Sparta Sand aquifer systems in Washington County could be reliably estimated prior to the completion of a well. This can be accomplished by using a representative formation factor, measurements from the long normal curve of a multi-resistivity electric log and the graphs presented here. Utilization of this method should allow for wells to be screened in the zone of least saline concentration, minimizing the chance for future increases in chloride concentration levels. (See also W88-04665) (Lantz-PTT)
W88-04685

LOW FLOW SUSTAINED BY GROUND WATER,
Hanover Univ. (Germany, F.R.).
R. Mull.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 67-97, 23 fig, 3 tab, 9 ref.

Descriptors: *Groundwater movement, *Flood flow, *Low flow, *Subsurface Water, *Forecasting, *Groundwater recharge, *Surface water, *Surface-groundwater relations, Rainfall impact, Groundwater storage, Reservoirs, Rainfall discharge, Mathematical modelling, Mathematical analysis, Seepage.

There is a demand for low flow forecast in certain industries, such as agriculture and forestry, and in authorities which are concerned with environmental protection. To satisfy this demand models have to be applied which transform precipitation into flow and which take account of the release of groundwater, such seasonal fluctuations as rainfall and evapotranspiration, and man-made effects like ground- or surface-water abstraction. The various phenomena affecting low flow, including hydrological aspects, are discussed together with an explanation of the basic concept of forecasting of low flow. A detailed discussion of rainfall-discharge relations is also included. An investigation of groundwater models, illustrating the limitations of these in predicting low flow as compared to hydrological models is reported. (See also W88-04686) (Bicht-PTT)
W88-04689

RISK ASSESSMENT FOR THE PROTECTION FROM AND THE PREVENTION OF GROUNDWATER CONTAMINATION,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 5G.
W88-04750

RECHARGE TO AND POTENTIAL FOR CONTAMINATION OF AN AQUIFER SYSTEM IN NORTHEASTERN WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
T. Feinstein, and M. P. Anderson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116751/AS. Price codes: A06 in paper copy, A01 in microfiche. Wisconsin Water Resources Center, Madison, Technical Report WIS-WRC 87-01, 1987. 112 p, 31 fig, 10 tab, 46 ref. Contract No. 14-08-0001-G942. Project No. USGS G942-05.

Descriptors: *Aquifers, *Glacial aquifers, *Groundwater movement, *Mathematical models, Computer models, Model studies, Wisconsin, Lower Fox River Basin, Simulation analysis, Recharge, Finite difference method.

The sandstone aquifer is the major groundwater reservoir for the communities of northeastern Wisconsin's lower Fox Valley. It lies below a shallow groundwater system composed of consolidated rocks of the Sinnipee Group and unconsolidated glacial deposits. A three-dimensional, steady-state, finite-difference model was constructed to determine the vulnerability of the deep reservoir to adverse effects of development at the surface. The model simulates groundwater flow from the water table through the shallow system to the St. Peter Sandstone at the top of the sandstone aquifer. By predicting the direction and magnitude of flow, the model identifies source areas for the aquifer and zones where contamination potential is high due to rapid communication between the water table and the St. Peter Sandstone. Field work helped to characterize the response of the water table to terrain and to quantify the hydraulic conductivity of the units overlying the aquifer. These findings were entered into a numerical model that reproduced the 1980 distribution of hydraulic head beneath a 278 sq. mile area sub-basin northwest of the city of De Pere. Because the shallow deposits in this area are in especially close hydraulic connection with the sandstone aquifer, groundwater supply for the lower Fox Valley depends largely on the quantity and quality of leakage through the sub-basin. Repeated application of Darcy's Law to the output of the calibrated model yielded the time and distance of flow along three-dimensional paths. The flow pattern indicates that the major source areas for wells in the sandstone aquifer are within the lower Fox Valley rather than west of it as previously believed. The end products of the study are a series of maps that delineate major recharge areas, zones of downward leakage, and zones of contamination potential with respect to the sandstone aquifer and a secondary aquifer at the top of the Sinnipee Group (USGS)
W88-04752

TRANSPORT OF SOLUTES THROUGH UNSATURATED FRACTURED MEDIA,
Sandia National Labs., Albuquerque, NM. Fluid and Thermal Sciences Dept.
R. C. Dykhuizen.
Water Research WATRAG, Vol. 21, No. 12, p 1531-1539, December 1987. 4 fig, 1 tab, 11 ref, append.

Descriptors: *Path of pollutants, *Solute transport, *Unsaturated flow, *Geologic fractures, Porous media, Hydraulic models, Groundwater movement.

A numerical model is presented to represent the transport of solutes through a highly fractured, unsaturated, porous medium. The solute is tracked separately in two flow systems, a matrix pore flow system and a fracture network, with interaction terms. Compatible hydraulic equations for such a dual system also are presented to enable solution of the solute transport equations. The chosen hydraulic equations use the equivalent porous media concept. These equations also can be applied without modification to a saturated medium. However, many of the transport terms will be negligible for such an application. A brief sample calculation for media at the Yucca Mountain site, Nevada, illustrates the method. (Author's abstract)
W88-04855

PROCEEDINGS OF THE OGALLALA AQUIFER SYMPOSIUM II,
Texas Tech Univ., Lubbock. Water Resources Center.
For primary bibliographic entry see Field 4B.
W88-04894

HIGH PLAINS REGIONAL AQUIFER -- GEOHYDROLOGY,
Geological Survey, Denver, CO.
J. B. Weeks, and E. D. Gutentag.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 6-25, 7 fig, 8 ref.

Descriptors: *Groundwater management, *Ogallala Aquifer, *Geohydrology, *Groundwater depletion, *Groundwater mining, Groundwater irrigation, Aquifer management, Groundwater recession, Aquifer systems, Groundwater potential, Groundwater recharge, Groundwater storage, Water quality, High Plains.

The High Plains aquifer underlies 174,000 square miles in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. The High Plains aquifer is a water-table aquifer consisting mainly of near-surface sand and gravel deposits of Tertiary and Quaternary age. The Tertiary Ogallala Formation, which underlies about 80% of the High Plains, is the principal geologic unit in the aquifer. The maximum saturated thickness of the aquifer is about 1,000 feet and

the average saturated thickness is about 200 feet. Precipitation is the principal source of recharge to the aquifer. Recharge rates range from 0.024 inch per year in parts of Texas to 6 inches per year in areas of dune sand in Kansas and Nebraska. About 3.25 billion acre-feet of drainable water is stored in the aquifer. During 1980, about 170,000 wells pumped almost 18 million acre-feet of water to irrigate nearly 14 million acres. Pumpage has caused areally extensive water-level declines in the aquifer. Since irrigation began in the High Plains, water levels have declined more than 10 feet in 50,000 square miles and more than 50 feet in 12,000 square miles. Water-level declines of as much as 200 feet have occurred since irrigation started and the volume of water in storage in the aquifer has decreased by 166 million acre-feet. About 70% of the depletion has occurred in Texas; about 16% of the depletion has occurred in Kansas. (See also W88-04894) (Author's abstract)
W88-04895

HIGH PLAINS REGIONAL AQUIFER -- FLOW-SYSTEM SIMULATION OF THE CENTRAL AND NORTHERN HIGH PLAINS,
Geological Survey, Lakewood, CO.
R. R. Luckey.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 48-66, 9 fig, 2 ref.

Descriptors: *Groundwater movement, *Simulation analysis, *Groundwater management, *High Plains Regional Aquifer, *Finite difference methods, Mathematical models, Groundwater irrigation, Artificial recharge, Groundwater storage, Return flow, Groundwater recharge.

The flow system in the High Plains aquifer was simulated using a digital, finite-difference technique to solve the groundwater flow equation. A regular network of nodes spaced ten miles apart in both north-south and east-west directions was used, and predevelopment and development periods were simulated for both areas of the High Plains. In the predevelopment period simulations, the average hydraulic conductivity and the recharge from precipitation were adjusted to obtain a correspondence between the observed and simulated water levels. The original estimates of average hydraulic conductivity were decreased in part of the central High Plains and increased in part of the northern High Plains. The estimated predevelopment recharge ranged from 0.056 to 0.84 inch per year for the central High Plains and from 0.076 to 1.52 inches per year for the northern High Plains. In the development-period calibrations, which were 30 years long for the central High Plains and 20 years long for the northern High Plains, return flow from irrigation and additional recharge caused by human activities were varied to obtain the best correspondence between observed and simulated historical water-level changes. Calibration of the central High Plains model was achieved when return flow was adjusted such that net withdrawal was 100% of the calculated irrigation demand. The simulated change in storage was 5 million acre-feet greater than the observed change in storage. Calibration of the northern High Plains model also was achieved when return flow was adjusted such that net withdrawal was 100% of the calculated irrigation demand. Additional recharge of 47.0 million acre-feet due to human activities was simulated for 1960-1980. The simulated change in storage was 9 million acre-feet more than the observed change in storage. (See also W88-04894) (Author's abstract)
W88-04898

OGALLALA DEPOSITIONAL MYSTERY,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
For primary bibliographic entry see Field 2J.
W88-04903

OGALLALA FORMATION IN EASTERN NEW MEXICO,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
J. W. Hawley.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 157-176, 2 fig, 68 ref.

Descriptors: *Ogallala Aquifer, *Alluvial deposits, *Alluvial aquifers, *Aquifer characteristics, *New Mexico, Geology, Geohydrology, Geologic formations, Geologic history, Alluvial plains, Paleoclimatology.

The Ogallala Formation in eastern New Mexico includes alluvial, eolian and lacustrine deposits of Miocene and Pliocene age (about 4-12 million yr.). Most research has focused on the Southern High Plains area where the formation is essentially continuous, locally more than 350 ft thick, and a major aquifer. West of the High Plains, in the source area for much of the unit, the Ogallala is discontinuous, commonly thin, and only locally an aquifer. The oldest deposits include piedmont fan alluvium, pediment veneers, and valley fills. They record early stages of epeirogenic uplift and tectonism in a broad area extending southward from the Rocky Mountains into the Sacramento section of the Basin and Range province, and eastward into the Great Plains. Differential uplift and depression of mountain and basin fault blocks occurred to the west along the Rio Grande rift margin; volcanism affected large areas of the Great Plains-Raton section; and solution-subsidence occurred in parts of the Pecos Valley section underlain by Permian evaporites. Since these processes were at least episodically active during Ogallala deposition, the distribution pattern of older and younger members is quite complex. The oldest units may be preserved as piedmont alluvium capping high divides and tablelands, with younger deposits occurring as inset valley fills; or they may form basal fills of structural basins, solution-subsidence depressions or stream valleys. Episodic deflation of alluvial plains prograding eastward from mountain and piedmont source areas also produced eolian deposits that are a significant component of the formation. Rising western highlands not only contributed much runoff and sediment to the Ogallala depositional system but also had a major influence on regional climate. The occurrence of prominent zones of secondary-carbonate accumulation in the middle to upper part of the formation indicates increasingly arid and more continental conditions in late Tertiary time. (See also W88-04894) (Author's abstract)
W88-04904

DEVELOPMENT AND ESCARPMENT RETREAT OF THE SOUTHERN HIGH PLAINS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2J.
W88-04905

COMMENTS ON THE GEOLOGIC HISTORY OF THE OGALLALA FORMATION IN THE SOUTHERN PANHANDLE OF NEBRASKA,
Nebraska Geological Survey, Lincoln.
For primary bibliographic entry see Field 2J.
W88-04906

ASSESSMENT OF THE GROUND-WATER RESOURCES OF THE TEXAS HIGH PLAINS,
Texas Dept. of Water Resources, Austin. Data and Engineering Services Div.
T. R. Knowles.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 217-237, 6 fig, 6 ref.

Descriptors: *Geohydrology, *High Plains Aquifer, *Subsurface mapping, *Aquifer characteristics, *Computer models, Geologic formations, Geologic mapping, Model studies, Hydraulic conductivity, Groundwater storage, Groundwater management, Groundwater irrigation, Groundwater depletion, Texas.

A regional groundwater study of the High Plains aquifer was completed in 1982 by the Texas Department of Water Resources to improve the data base describing the High Plains Aquifer and to develop a computer model to predict future conditions in the aquifer. Approximately 14,000 data points were used to construct a detailed altitude to base of High Plains Aquifer map. Over 3,800 wells were measured to provide a detailed 1980 water-level map. These two maps combined provided a more accurate saturated thickness map. Lithologic descriptions were used to construct maps of specific yield and permeability. A two-part digital model of the aquifer in Texas was constructed and calibrated for the period 1960-1980. From this model it was determined that the aquifer had an average specific yield of 16% and an average permeability of 400 gal/day/ft. An average annual recharge rate of 0.2 inch or 372,000 acre-feet was applied to the entire area. In 1960, the aquifer contained 505.43 million acre-feet of water and in 1980, 420.56 million acre-feet, with 91.5% of it recoverable. Assuming continuation of present water-use trends, the aquifer would contain 341.66 million acre-feet of water in 2000 and 259.89 million acre-feet in 2030, reductions of 18.7 and 38.2%, respectively, from the 1980 level. Corresponding reductions in acres irrigated from 1980 are 14.4% and 42.7%, respectively. If management practices were implemented to significantly reduce irrigation application rates, the aquifer would contain 363.46 million acre-feet of water in 2000 and 310.66 million acre-feet in 2030, reductions of 13.6% and 26.1%, respectively. Corresponding reductions in acres irrigated are 7.4% and 17.1%, respectively. (See also W88-04894) (Author's abstract)
W88-04907

HYDROLOGIC CHARACTERISTICS AND GROUND-WATER AVAILABILITY IN THE HIGH PLAINS AQUIFER SYSTEM IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
R. A. Pettijohn, and H. H. Chen.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 238-264, 10 fig, 26 ref.

Descriptors: *High Plains Aquifer, *Geohydrology, *Hydrologic models, *Aquifer characteristics, *Groundwater potential, Hydraulic conductivity, groundwater storage, Groundwater level, Groundwater recession, Groundwater depletion, Nebraska.

The High Plains aquifer system, which underlies about 65,000 square miles in Nebraska, consists of the Ogallala Formation and Tertiary and Quaternary deposits that are saturated and hydraulically connected to the Ogallala. The hydraulic conductivity of the aquifer system varies from <25 to >300 feet per day. Specific yield varies from $<5\%$ to 30% in most of the system and averages 16%. The saturated thickness varies from 200 feet or less in 34% of the aquifer area to >600 feet in 18% of the aquifer area, and exceeds 400 feet in 33% of the aquifer area. The volume of water in storage and the volume of water recoverable from the aquifer system are estimated to be 4.89 and 2.25 billion acre-feet, respectively. The average quantity of water withdrawn from the aquifer system during 1980 varied from <1.5 inches in areas of the sandhills of north-central Nebraska to >12 inches in areas of the central Platte River and Blue River basins. Total groundwater withdrawal from approximately 64,000 wells was about 6.703 million acre-feet. The quantity of water available from a selected area of the aquifer system may be estimated by incorporating the hydrologic and pumpage data for that area into a digital flow model. Box Butte County in northwest Nebraska is one of several areas within the aquifer system where a digital flow model has been used to estimate projected water-level changes due to various development rates. Based on the maximum development rate used in that model, groundwater levels are projected to decline 30 feet or more in an area of 240 square miles between 1982 and 1991. (See also W88-04894) (Author's abstract)
W88-04908

ESTIMATION OF SPECIFIC YIELD USING DRILLERS' LITHOLOGIC DESCRIPTIONS,
Texas Dept. of Water Resources, Austin. Data Collection and Evaluation Section.
P. L. Nordstrom.

IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 265-277, 3 fig, 1 tab, 9 ref.

Descriptors: *Ogallala Aquifer, *Lithologic logs, *Specific yield, *Subsurface mapping, *Computer programs, Geohydrology, Saturated zone, Geologic mapping, Groundwater potential.

The layering of different lithologic units comprising the Ogallala permits the use of vertical variability techniques to estimate specific yield. One such method uses lithologic descriptions reported by water well drillers and a computer program, ENCOMP, to calculate a weighted mean specific yield at a selected well site. Using this method, estimates of specific yield for each lithologic interval on the drillers' log within the saturated zone are input into the program. Dealing solely with the saturated interval requires the input of the approximate water level at that site. Permeability, specific yield, and saturated thickness values and statistics on the vertical distribution of aquifer parameters within the saturated interval are computed at each site. A regional map showing specific yield was constructed using a well density sufficient to provide uniform coverage. Values derived from this regional map were incorporated into the digital model of the aquifer. The specific yield map which is included in Texas Department of Water Resources publication number LP-173 was drawn after specific yield values were adjusted during calibration of the digital model. Map values should be considered as no more than average regional values suitable for identifying trends. A specific yield map used in conjunction with a saturated thickness map can be a useful tool in identifying areas in an aquifer where water-yielding capabilities are greatest. (See also W88-04894) (Author's abstract)
W88-04909

HYDRAULIC CHARACTERISTICS OF THE HIGH PLAINS AQUIFER AS DETERMINED FROM CORE ANALYSIS,
Texas Dept. of Water Resources, Austin. Data Collection and Evaluation Section.
J. B. Ashworth.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 278-291, 3 fig, 3 tab, 7 ref.

Descriptors: *Aquifer characteristics, *Core drilling, *Specific yield, *High Plains Aquifer, *Ogallala Aquifer, Saturated zone, Groundwater management, Permeability, Porosity, Hydraulic properties, Deposition, Texas.

Hydraulic characteristics of the High Plains (Ogallala) aquifer in Texas were studied during an extensive test hole drilling project conducted by the texas Department of Water Resources. Cores retrieved from the saturated zone of 41 test holes located in 36 counties were analyzed for porosity, specific yield, permeability, and grain-size distribution. The core analyses indicate that: transmissivities range from 315 to 201,000 gallons per day per foot ((gal/d)/ft) with an overall average of 30,400 (gal/d)/ft; permeabilities range from 22 to 1,934 gallons per day per square foot ((gal/d)/sq ft) with an overall average of 232 (gal/d) sq ft; and specific yield ranges from 7.23 to 19.54% with an overall average of 16.06%. A statistical analysis of the data indicates that the center of gravity for both transmissivity and specific yield occurs about midway through the saturated interval, and the standard deviation indicates a lack of concentration about the center of gravity. Permeability and specific yield thus appear to be evenly distributed throughout the saturated zone. The primary environment of deposition was determined for the saturated zone in each test hole based on lithologic description, characteristic geophysical log patterns, and results of laboratory testing of samples. Four distinct lithofacies were identified, consisting of sediments from the following environments: fluvial channel, interdistributary, frontal fan slope, and distributary mouth. The fluvial channel and distributary mouth lithofacies characteristically have higher specific yields than the other lithofacies while fluvial channel deposits have a much greater range of permeability. (See also W88-04894) (Author's abstract)
W88-04910

PLAYA LAKE BASINS ON THE SOUTHERN HIGH PLAINS OF TEXAS, U.S.A.: A HYPOTHESIS FOR THEIR DEVELOPMENT,
Geological Survey, Reston, VA.
W. W. Wood, and W. R. Osterkamp.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 304-311, 2 fig, 13 ref.

Descriptors: *Playas, *Ogallala Aquifer, *Geologic history, *Unsaturated zone, *Carbon dioxide, *Texas, Geomorphology, Geology, Ephemeral lakes, Suspended solids, Geohydrology, Groundwater recharge, High Plains.

Many of the approximately 30,000 playa-lake basins of the Southern High Plains are postulated to have enlarged and developed by eluviation, micropiping, and carbonate solution in the unsaturated zone of the Ogallala Aquifer, rather than by deflation as is commonly stated in the geologic literature. Geologic, geomorphic, and hydrologic observations suggest that processes other than eolian must be responsible for basin development although the initial protodepressions are probably of eolian origin. Measurement of CO2 flux leaving the unsaturated zone has permitted an estimate of the amount of organic material, and by inference the amount of inorganic material, entering the unsaturated zone. This technique suggests that approximately 1300 grams/square meter/year are carried into the unsaturated zone by recharging water. Removal of this material results in a lowering of the basin by 0.76 meter/1,000 years. The proposed particulate-transport mechanism also identifies a source of CO2 essential for the dissolution of caliche that is observed to be occurring deep in the unsaturated zone. (See also W88-04894) (Author's abstract)
W88-04912

RECHARGE OF THE OGALLALA AQUIFER THROUGH EXCAVATED BASINS,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 4B.
W88-04914

RECHARGE TO THE OGALLALA AQUIFER FROM PLAYA LAKE BASINS ON THE LLANO ESTACADO (AN OUTRAGEOUS PROPOSAL),
Geological Survey, Reston, VA.
W. W. Wood, and W. R. Osterkamp.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 337-349, 2 fig, 1 tab, 23 ref.

Descriptors: *Groundwater recharge, *Ogallala Aquifer, *Artificial recharge, *Playas, *Groundwater management, Ephemeral lakes, Tritium, Salinity, Geohydrology, Minerals, Recharge ponds, Recharge basins, Solute transport, Natural recharge, Llano Estacado, Chemical analysis.

Water-budget studies suggest that much of the recharge to the Ogallala Aquifer in the Llano Estacado is from the 30,000 playa lakes rather than from outerbasin areas, ephemeral streams, or areas of sand dunes. Most recharge from the basins is believed to occur in the small annulus immediately surrounding the playa floors. Hydrographs of wells near playa lakes show that groundwater levels rise rapidly as playa lake levels fall, which is consistent with the concept that recharge occurs through playa lake basins. Chemical analyses of lake water collected during periods of rapid lake-level decline suggest that solutes are transported to the subsurface with recharging water rather than being concentrated by evaporation. Solutes also are observed to have a lower concentration in the unsaturated zone beneath the annulus than in the outerbasin areas, which implies greater infiltration through the annulus than through the outerbasin areas. These is no indication of saline minerals or clay minerals usually associated with saline environments in typical playa-lake sediments. This observation is consistent with movement of solutes through the playa sediments, rather than evaporative concentration of solutes in them. The species of vegetation associated with playa sediments are not related to salinity but rather to soil type. Elevated concentrations of tritium, occasionally observed in the groundwater samples (post bomb), are consistent with the concept of local, intense recharge rather than of diffuse regional recharge. Caliche, which presently is forming approximately a meter below the land surface in outerbasin areas, suggests that little recharge occurs in these areas. This is in contrast with the dissolution of large amounts of caliche that has occurred beneath many playa floors. Since most of the recharge of groundwater to the Ogallala Aquifer underlying the Llano Estacado appears to be through the annulus immediately surrounding the basin floor, any soluble waste material placed beneath or on the playa has a high probability of entering the aquifer. (See also W88-04894) (Author's abstract)
W88-04915

POTENTIAL FOR ARTIFICIAL RECHARGE OF THE NORTHERN HIGH PLAINS OF COLORADO,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W88-04916

PRELIMINARY ESTIMATES OF OGALLALA-AQUIFER RECHARGE USING CHLORINE IN THE UNSATURATED ZONE, CURRY COUNTY, NEW MEXICO,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
W. J. Stone.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 376-391, 5 fig, 3 tab, 14 ref.

Descriptors: *Groundwater recharge, *Natural recharge, *Unsaturated zone, *Chlorides, *Ogallala Aquifer, Neutron activation analysis, Groundwater management, Unsaturated zone, Return flow, Soil water, Mapping, Return flow, Infiltration rate, Playas, Sand, High Plains, New Mexico.

The chloride method of estimating aquifer recharge was applied to four settings typical of the High Plains near Melrose, New Mexico: playa, nonirrigated cover sand, sand hills, and irrigated cover sand. Recharge was estimated to be highest beneath the playa: 2.80 mm/yr (0.11 inch/yr). This reflects the greater availability of moisture there due to occasional run-on and temporary ponding. Lowest recharge estimates were associated with the irrigated and non-irrigated cover sand (Blackwater Draw Formation): 0.18 and 0.24 mm/yr (approximately 0.01 inch/yr), respectively. Although the surficial material at these sites is sand, water use by plants as well as the depth and nature of the underlying Ogallala cap-rock caliche are additional control of recharge. An intermediate value of 1.25 mm/yr (0.05 inch/yr) was determined for the sand-hills site. A higher recharge rate is expected there because of the sand-dune setting even though the auger hole for this site was spudded in a bare caliche surface exposed between eroded dune remnants. These preliminary results compare well with both published average recharge rates from other methods applied to the High Plains and with results of the chloride method from similar terrain in South australia. The method should prove useful in preparing recharge maps and perhaps in determining irrigation return flow. (See also W88-04894) (Author's abstract)
W88-04918

HYDROGEOLOGY OF THE PALO DURO BASIN: INTERACTIONS WITH THE OGALLALA AQUIFER,
Texas Univ. at Austin. Bureau of Economic Geology.
C. W. Kreitler, and A. R. Dutton.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 392-404, 2 fig, 1 tab, 29 ref. DOE Contract No. DE-AC97-83WM46651.

Descriptors: *Geohydrology, *Ogallala Aquifer, *Aquitards, *Groundwater recharge, *Groundwater movement, Geologic formations, Permeability, Aquifers, Natural recharge, Potentiometric level, Aquifer characteristics, Geology, High Plains.

The Palo Duro Basin underlies the northern part of the Southern High Plains. Strata in the basin can be divided into three geohydrologic units: the above-salt aquifers (High Plains aquifer), which includes the Neogene Ogallala and Triassic Dockum deposits, the Permian evaporite aquitard (Evaporite aquitard), which is composed of Leonardian, Guadalupian, and Ochoan deposits of salt, anhydrite, red beds, and dolomite; and the subsalt brine aquifers (Deep-Basin Brine aquifer), which is principally Lower Permian (Wolfcampian) and Upper Pennsylvanian carbonates and arkosic granite-wash deposits. Recharge to the High Plains aquifer is predominantly by infiltration of precipitation on the outcrop. Groundwater flow is from west to east with discharge along the Eastern Caprock Escarpment or into the Canadian River Valley. In places the Ogallala and Dockum aquifers appear to be hydrologically isolated. Even though the permeability of the Evaporite aquitard is estimated to be very low (80 nanodarcies), there may be fluid flow through the evaporite rocks and associated carbonates, both horizontally and vertically downward. The Deep-Basin Brine aquifer is recharged at the outcrop in New Mexico and by leakage through the salt section. Potentiometric surface differences between the High Plains aquifer and the Deep-Basin Brine aquifer indicate a potential for downward flow. Groundwater flow is from west to east or northeast; probable discharge is east of the High Plains in the Permian Rolling Plains of North-Central Texas and Oklahoma. (See also W88-04894) (Author's abstract)
W88-04919

RISING WATER LEVELS – AN ASSET AND A LIABILITY TO TEXAS TECH UNIVERSITY,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W88-04921

RISING GROUNDWATER LEVELS, TEXAS TECH UNIVERSITY,
Camp, Dresser and McKee, Inc., Austin, TX.
For primary bibliographic entry see Field 4B.
W88-04922

MATHEMATICAL MODEL OF THE SECONDARY RECOVERY PROCESS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W88-04932

TECHNICAL LITERATURE ON SECONDARY RECOVERY OF GROUNDWATER AND PETROLEUM,
Texas Tech Univ., Lubbock. Water Resources Center.
For primary bibliographic entry see Field 4B.
W88-04933

RADON, RADIUM AND OTHER RADIOACTIVITY IN GROUND WATER: HYDROGEOLOGIC IMPACT AND APPLICATION TO INDOOR AIRBORNE CONTAMINATION.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5B.
W88-04980

SOURCE AND DISTRIBUTION OF NATURAL RADIOACTIVITY IN GROUND WATER IN THE NEWARK BASIN, NEW JERSEY,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 5B.
W88-04984

ELEVATED LEVELS OF RADIOACTIVITY IN WATER WELLS IN LOS ANGELES AND ORANGE COUNTIES, CALIFORNIA,
Alton Geoscience, Irvine, CA.
For primary bibliographic entry see Field 5B.
W88-04985

PRELIMINARY ASSESSMENT OF FACTORS AFFECTING RADON LEVELS IN IDAHO,
Tennessee Technological Univ., Cookeville. Water Resources Center.
For primary bibliographic entry see Field 5B.
W88-04986

NATURAL RADIOACTIVITY IN SOME GROUNDWATERS OF THE CANADIAN SHIELD,
Atomic Energy of Canada Ltd., Pinawa (Manitoba).
For primary bibliographic entry see Field 5B.
W88-04987

RADON IN GROUNDWATER OF THE LONG VALLEY CALDERA, CALIFORNIA,
Lawrence Berkeley Lab., CA.
For primary bibliographic entry see Field 5B.
W88-04989

FACTORS CONTROLLING URANIUM AND RADIUM ISOTOPIC DISTRIBUTIONS IN GROUNDWATERS OF THE WEST-CENTRAL FLORIDA PHOSPHATE DISTRICT,
For primary bibliographic entry see Field 5B.
W88-04991

SAMPLING AND ANALYSIS OF DISSOLVED RADON-222 IN SURFACE AND GROUND WATER,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5A.
W88-04992

RADON-222 CONCENTRATION OF GROUNDWATER FROM A TEST ZONE OF A SHALLOW ALLUVIAL AQUIFER IN THE SANTA CLARA VALLEY, CALIFORNIA,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04993

NATIONWIDE DISTRIBUTION OF RA-228, RA-226, RN-222, AND U IN GROUNDWATER,
RPA International, Inc., Columbia, SC.
For primary bibliographic entry see Field 5B.
W88-04995

RADON MEASUREMENT IN STREAMS TO DETERMINE LOCATION AND MAGNITUDE OF GROUND-WATER SEEPAGE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5A.
W88-04996

POLONIUM IN THE SURFICIAL AQUIFER OF WEST CENTRAL FLORIDA,
Florida State Univ., Tallahassee.
For primary bibliographic entry see Field 5B.
W88-04997

TECHNIQUE FOR THE RAPID EXTRACTION OF RADON-222 FROM WATER SAMPLES AND A CASE STUDY,
University of Southern California, Los Angeles.
For primary bibliographic entry see Field 5A.
W88-04998

RELATION BETWEEN NATURAL RADIONUCLIDE ACTIVITIES AND CHEMICAL CONSTITUENTS IN GROUND WATER IN THE NEWARK BASIN, NEW JERSEY,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2K.
W88-04999

RADON SURVEY OF THE AMERICAN WATER WORKS SYSTEM,
American Water Works Service Co., Marlton, NJ.
For primary bibliographic entry see Field 5A.
W88-05000

CONNECTICUT RADON STUDY- USING LIMITED WATER SAMPLING AND A STATEWIDE GROUND-BASED GAMMA SURVEY TO HELP GUIDE AN INDOOR AIR TESTING PROGRAM. A PROGRESS REPORT:,
Connecticut Dept. of Environmental Protection, Hartford. Natural Resources Center.
For primary bibliographic entry see Field 5A.
W88-05001

RADON PRODUCTION IN PUMPING WELLS,
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 5B.
W88-05005

RADIUM-228 AND RADIUM-226 IN GROUND WATER OF THE CHICKIES FORMATION, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Malvern, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-05006

HYDROGEOLOGIC CONTROLS ON THE OCCURRENCE OF RADIONUCLIDES IN GROUNDWATER OF SOUTHERN ONTARIO,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W88-05007

MEASUREMENTS OF GROUNDWATER SEEPAGE FLUX ONTO A CORAL REEF: SPATIAL AND TEMPORAL VARIATIONS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W88-05096

2G. Water In Soils

USE OF SORPTIVITY TO DETERMINE FIELD SOIL HYDRAULIC PROPERTIES,
I. White, and K. M. Perroux.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1093-1101, September-October 1987. 9 fig, 3 tab, 32 ref. Australian Water Research Council Grant No. 84/157.

Descriptors: *Sorptivity, *Soil water, *Hydraulic properties, *Soil structures, *Geohydrology, *Groundwater movement, Permeability coefficient, Soil water potential, Mathematical studies, Capillary water, Soil properties.

Convenient and reliable techniques for estimating intact soil hydraulic properties are required for predictions of soil water flow in the environment. The dependence of sorptivity, S, on water supply potential, psi sub o, was used to find the dependence of the intact field soil hydraulic properties soil water diffusivity, D(theta), hydraulic conductivity, K(theta), and soil-water characteristic psi(theta) on water content, theta. The approximations used in deconvoluting sorptivity are examined critically suing a simple parametric D(theta) that gives analytic solutions applicable to most known soil behavior. The Parlange approximation is shown to differ from the exact solution by $<5\%$ over a very wide range of D(theta) and over the entire water content range. A rapidly convergent iterative scheme in which this approximation forms the initial estimate was introduced for situations where greater accuracy is required. The technique was tested for a repacked soil, Ustochrept, and the D(theta) derived from S(psi sub theta) agrees with

conventional measurements. The disc permeameter was used to find S(psi sub theta) at 20 sites for an intact field soil, Haplustalf. The D(theta) derived from these measurements is not strongly theta-dependent. This is attributed to the shape of psi(theta), which, in contrast to repacked samples, shows that as theta approaches saturation, psi approaches zero gradually. The capillary length found from the K(psi) measurements is only 23 mm. Both findings are attributed to the presence of biopores in the field soil. Sorptivity may be used to determine reliably intact soil hydraulic properties whose magnitudes reflect the intricacies of field soil structure. (Author's abstract)
W88-04495

ENERGY AND WATER BALANCE OF A SPARSE CROP: SIMULATED AND MEASURED SOIL AND CROP EVAPORATION,
Texas Agricultural Experiment Station, Lubbock.
R. J. Lascano, C. H. M. Van Bavel, J. L. Hatfield, and D. R. Upchurch.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1113-1121, September-October 1987. 12 fig, 2 tab, 23 ref. Agency for International Development Grant No. DAN-1311-6-SS-1083-00.

Descriptors: *Crop yield, *Simulation analysis, *Soil water, Semiarid lands, Evapotranspiration, Hydrologic budget, Model studies, Cotton.

Dryland crops grown in semiarid environments often do not completely cover the soil, leaving a portion of the soil surface exposed to a condition of rapid soil-water evaporation. Quantitative separation of soil evaporation and crop transpiration is important if cultural practices or cultivars are to be evaluated. This study was designed to evaluate a combined energy and water balance model, ENWATBAL, to describe the concurrent heat and water fluxes in a row crop. Inputs to the model include soil and plant variables and daily weather data. Measurements were made for a period of 74 days over a cotton canopy during 1985 on an Olton soil (fine, thermic Aridic Paleustolls) at Lubbock, TX. Data collected included soil-water content, soil temperature, root distribution, soil evaporation with microlysimeters, and leaf area index, for both an irrigated and a dryland plot. The values for daily evaporation and evapotranspiration calculated with the model were within 1 standard deviation of the measured values. Cumulative evaporation and evapotranspiration from the model agreed with measured values within 7% for the dryland and 8% for the irrigated plot. Estimated soil-water and temperature profiles also agreed closely to measured values. Soil evaporation was found to be 30% of evapotranspiration, for both the irrigated and the dryland plot. The ENWATBAL model provides a reliable method of evaluating the effects of management practices and crop selection on the water-use efficiency of crop production in a semiarid area. (Author's abstract)
W88-04496

COMPUTED TOMOGRAPHIC ANALYSES OF WATER DISTRIBUTION IN THREE POROUS FOAM MEDIA,
North Carolina State Univ., Raleigh. Dept. of Horticultural Science.
J. M. Brown, W. C. Fonteno, D. K. Cassel, and G. A. Johnson.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1121-1125, September-October 1987. 6 fig, 1 tab, 10 ref.

Descriptors: *Computer assisted tomography, *Remote sensing, *Soil water, Monitoring, Data acquisition, X-rays.

Computer Assisted Tomography (CAT) is commonly used in diagnostic radiology to make nondestructive images and analyses of cross sections of the human body. CAT scanning may also be useful in imaging and measuring spatial distribution and changes in water distribution in porous media. Details of CAT scanning that are important to the application of CAT scanning porous media are reviewed and the use of the CAT scanner to measure the spatial distribution of water in three different porous media was evaluated. The scanner's response to changes in the spatial distribution of water in three different porous phenolic foam materials after draining for 16 hr was investigated. Water content distributions were successfully detected with good resolution on the x-ray image. Comparisons of CAT vs. gravimetrically determined water content indicated a significant linear relationship between the methods. Results from these experiments indicate that the CAT scanner can nondestructively measure volume wetness in phenolic foam media. The clarity of the CAT images suggests that CAT scanning has great potential for studies where small and rapid changes in water content within small volumes of media are desired. (Author's abstract)
W88-04497

EFFECT OF ALUMINUM AND IRON OXIDES ON HYDRAULIC CONDUCTIVITY OF SANDY LOAM SOIL,
California Univ., Davis. Dept. of Land, Air and Water Resources.
I. Shainberg, M. J. Singer, and P. Janitzky.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1283-1287, September-October 1987. 2 fig, 4 tab, 18 ref.

Descriptors: *Soil amendments, *Soil management, *Aluminum, *Iron, *Permeability coefficient, *Sands, *Loam, *Soil water, Geohydrology, Sodium, Leaching.

Iron and aluminum oxides and hydroxides have been shown to stabilize pure clay systems from the effect of high exchangeable sodium percentage (ESP). This study examined the effect of Fe and Al additions on the stability of a California Alfisol with serious crusting problems. Changes in saturated hydraulic conductivity were used as a measure of treatment effectiveness. Saturated hydraulic conductivity (HC) of a sandy loam equilibrated with sodium adsorption ratio (SAR) 20 CACl2-NaCl solution and leached with distilled water was faster for samples treated with 20 and 40 mmol/kg of FeCl3 or AlCl3 compared with untreated and 10 mmol/kg treatments. The FeCl treatments were more effective than AlCl3 treatments in maintaining HC. Analysis of the column effluent showed that more Al than Fe was removed during leaching. Much of the Fe added to the soils is recovered in oxalate and citrate-bicarbonate-dithionite (CBD) extracts, but little Al is recovered because the added Al is removed with the effluent. The stabilizing effect of hydroxy-Fe polymers against the deleterious effect of exchangeable Na was related to the charge on the polymers and not with the total amount extracted. (Author's abstract)
W88-04498

HYDRAULIC CONDUCTIVITY OF THREE SOUTHEASTERN SOILS AS AFFECTED BY SODIUM, ELECTROLYTE CONCENTRATION, AND PH,
Georgia Univ., Athens. Dept. of Agronomy.
S. C. Chiang, D. E. Radcliffe, W. P. Miller, and K. D. Newman.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1293-1299, September-October 1987. 8 fig, 2 tab, 19 ref.

Descriptors: *Soil management, *Soil amendments, *Permeability coefficient, *Soil water, *Sodium, *Hydrogen ion concentration, Electrolytes, Absorption, Ion exchange, Cation exchange, Soil properties.

In the humid southeastern USA, little attention is given to the effect of electrolyte concentration or low levels of Na on clay dispersion, although dispersion-related phenomenon such as surface crusting and erosion are common. The objective of this study was to determine the effect of electrolyte concentration, sodium absorption ratio (SAR), and soil pH on saturated hydraulic conductivity of three soils that differed in parent material. Cores packed with sieved soil at different pHs were leached with 10 pore volumes of solution at varying SAR and electrolyte concentrations. The relative decrease in conductivity during leaching was recorded as a measure of clay dispersion and subsequent clogging of pores. The Cecil soil (Typic Hapludult), which is derived from granitic parent material, was easily dispersed and hydraulic conductivity was sensitive to small changes in electrolyte concentration, SAR, or pH. The Davidson (Rhodic Paleudult) and Iredell (Typic Hapludalf) soils, derived from matric parent material, were flocculated and insensitive to changes in electrolyte concentration and pH except at very high SAR. The implications are that southeastern soils may differ greatly in structural stability and this may be related to parent material. Dispersive soils need to be identified and managed in an appropriate manner. (Author's abstract)
W88-04499

VARIABILITY OF INFILTRATION IN A FIELD WITH SURFACE-SEALED SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
M. Ben-Hur, I. Shainberg, and J. Morin.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1299-1302, September-October 1987. 2 fig, 2 tab, 17 ref.

Descriptors: *Soil sealants, *Surface sealing, *Soil water, *Infiltration, *Infiltration rate, *Flooding, Infiltrometer, Permeability coefficient, Cation exchange, Sodium.

The infiltration rates (IR) for water were measured at 30 random sites within a 1-ha field by sprinkler and flood infiltrometers. A portable rainfall infiltrometer was used to measure the infiltration rate under water-drop impact conditions, and double-ring infiltrometers were used to measure IR in flooded conditions. No spatial dependence of the steady-state IR values measured with the two methods was found. The mean steady-state IR measured with the flood infiltrometer was 57.8 mm/ha with a coefficient of variation (CV) of 41.8%. The mean steady-state IR measured with the sprinkler infiltrometer was 8.6 mm/ha with a CV of 14.7%. This difference was due to the formation of a soil surface seal from the impact of falling drops. The seal's hydraulic conductivity was much lower and less variable than that of bulk soil. Frequency distributions of the steady-state IRs measured with the two methods were different; that from the double-ring infiltrometer had a small deviation to the left, while that of the sprinkler infiltrometer had a large deviation to the right. The distribution of steady-state sprinkler IR values corresponds with the distribution in the cation exchange capacity (CEC) and exchangeable sodium percentage (ESP) in the field, verifying the known dependence between surface seal formation and the soil CEC and ESP relationship. This dependence was not found for the IR values measured by flooding. No correlation was found between the IR values measured by the two methods. Thus, for soils that seal, it is impossible to predict IR under water drops from measurements under flooding conditions. (Author's abstract)
W88-04500

INFILTRATION AND SOIL LOSS OF THREE GYPSUM-AMENDED ULTISOLS UNDER SIMULATED RAINFALL,
Georgia Univ., Athens. Dept. of Agronomy.
For primary bibliographic entry see Field 2J.
W88-04503

MINIMIZING INTERPRETATION AMBIGUITIES THROUGH JOINT INVERSION OF SURFACE ELECTRICAL DATA,
Geophysics Group, San Diego, CA.
For primary bibliographic entry see Field 7B.
W88-04552

BROMIDE AS A CONSERVATIVE TRACER FOR SOIL-WATER STUDIES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
B. S. Levy, and R. M. Chambers.
Hydrological Processes HYPRE3, Vol. 1, No. 4, p 385-389, November 1987. 3 fig, 2 tab, 16 ref.

Descriptors: *Bromide, *Soil water, *Tracers, Statistical analysis, Analysis of variance, Sorption, Soil profiles, Potassium bromide.

The assumption that potassium bromide is conservative tracer for soil-water studies was tested in a series of batch sorption experiments, conducted on soil samples collected from the O, E, and A horizons of the Albemarle soil series near Charlottesville, VA. The experiments were conducted under conditions of differing bromide concentration and filter treatments. Bromide concentrations in soil-solution mixtures were measured through time using an Orion bromide-specific electrode. An analysis of variance of results showed no significant sorption of bromide through time under any concentration level or filter treatment (alpha = 0.01). No sorption of bromide between different soil horizons could be determined. This work clearly indicates that bromide is conservative under the conditions examined. (Author's abstract)
W88-04575

ISOTOPIC INVESTIGATION OF SOIL WATER MOVEMENT: A CASE STUDY IN THE THAR DESERT, WESTERN RAJASTHAN,
Physical Research Lab., Ahmedabad (India).
P. Sharma, and S. K. Gupta.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 4, p 469-483, December 1987. 5 fig, 3 tab, 15 ref. IAEA Contract Research Project No. 3154 R1/GS.

Descriptors: *Groundwater recharge, *Tracer studies, *Groundwater movement, *Ahmedabad, *Sabarmati Basin, *Aeration zone, *Thar Desert, *Rajasthan, Arid lands, Isotope studies, Rainfall, Recharge, India, Tritium, Hydrologic models, Evapotranspiration, Runoff.

A proper understanding of soil moisture movement in the unsaturated zone is of considerable importance in understanding and estimating groundwater recharge. Conventional methods, e.g., inventory, storage, lysimetric methods etc., require the availability of a long-term hydrometeorological data base for the area under consideration. Because of this constraint, there has been, in recent years, an increasing emphasis on the use of isotopic techniques, involving environmental and artificial tritium, for estimating groundwater recharge has been used in the arid region of the Thar desert, western Rajasthan (India). The study reveals considerable spatial variability of groundwater recharge in the areas investigated, between 6 and 14% of the rainfall input. The technique has yielded some insight into the variability of groundwater recharge in the arid region of the Thar desert. A simplified evapotranspiration-runoff model has also been developed to estimate regional groundwater recharge based on tritium studies. Since detailed hydrometeorological data for the Thar desert were not available, the results of a similar controlled tritium-tagging study at Ahmedabad have been used to test the applicability of this model. Ahmedabad, situated in the Sabarmati basin, Gujarat State, has rainfall about three times higher than that of the Thar desert but is still on the fringe of the desert in the semiarid region of northwest India. (Author's abstract)
W88-04592

SOIL WATER MOVEMENT ESTIMATED FROM ISOTOPE TRACERS,
Uppsala Univ. (Sweden). Dept. of Hydrology.
L. Bengtsson, R. K. Saxena, and Z. Dressie.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 4, p 497-520, December 1987. 6 fig, 7 tab, 28 ref.

Descriptors: *Soil water, *Isotope studies, *Tracers, *Groundwater movement, Oxygen radioisotopes, Tritium, Flow rate, Percolation, Recharge, Eskers, Groundwater recharge, Snowmelt, Sweden.

The natural isotope oxygen-18 and artificially injected tritium are used for studying the percolation of soil water. Particle velocity, progression rate and soil moisture flux are distinguished from each other. Water particle velocities and seasonal groundwater recharge are determined in glacio-fluvial deposits and in till soils. In the glacio-fluvial deposits of the Uppsala (Sweden) esker it is found that the groundwater recharge is distributed rather uniformly over the year, although high soil moisture flux near the ground surface is caused by single episodes. Downward particle velocities in the unsaturated zone below the root zone in the investigated glacio-fluvial esker formation are about 1.5 m/yr. The groundwater is recharged throughout the year. The annual recharge of about 250 nm emanates to about the same extent from snowmelt and from rainfalls in the autumn. The recharge rates do not exceed 1-2 mm/day. Where the glacio-fluvial deposits are more unsorted than in the esker formation, percolating water travels along different pathways at different particle velocities. The average travel velocity over a year in the unsorted soils is about 2.5 m/yr. (Lantz-PTT)
W88-04594

SOIL HEAT AND WATER FLOW WITH A PARTIAL SURFACE MULCH,
Iowa State Univ., Ames. Dept. of Agronomy.
S. O. Chung, and R. Horton.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2175-2186, December 1987. 9 fig, 6 tab, 30 ref. Iowa Agriculture and Home Economics Experiment Station Project Nos. 2556 and 2715.

Descriptors: *Soil temperature, *Soil water, *Evapotranspiration, *Mulching, *Surface flow, Simulation, Model studies, Surface groundwater relations, Mathematical models, Hydraulic properties, Drainage, Evaporation, Temperature, Radiation.

A computer model using the alternating direction implicit (ADI) finite difference method to study two-dimensional coupled soil heat and water flow with a partial surface mulch cover is developed. A new, simplified computational procedure for the ADI method that has only tridiagonal matrix problems is introduced. The model uses a soil surface energy balance equation to determine soil surface boundary conditions for both heat and water flow. The inputs required for the computer simulations are weather data, soil thermal and hydraulic properties, and mulch data. Numerical experiments were performed to examine the effects of soil type, mulch width, and weather conditions on soil heat and water movement. For continuous evaporation and drainage, 10-day simulations were performed for each combination of clay, loam, and sand soil and fractions of mulch cover of 0, 0.5, 0.8, and 1.0 of the row interval width. Conclusions from this simulation study include: (1) The net radiation heat flux is much smaller and the sensible heat flux is much greater on the mulch than on the bare soil surface when the soil surface is relatively wet; (2) The net radiation energy is partitioned mainly to latent heat as long as the soil surface is relatively wet; (3) The soil surface temperatures are very high when the soil surface approaches its residual water content because incoming net radiation is used to heat up the soil surface instead of to evaporate soil surface moisture; (4) The amplitudes of daily temperature, water content, and pressure head variation under the mulch are much smaller than those on the bare soil surface, and decrease rapidly as soil depths increase; (5) The soil heat and water flow is nearly one-dimensional below a soil depth of 40 cm; (6) The lateral heat and water flows near the soil surface with a partial mulch cover are significant; (7) The mulch cover suppresses the soil water evaporation to a large extent, but has only a small impact on soil water drainage; (8) The partial mulch cover does not have a large effect on the water content at the 5-cm depth, where the plant seeds are located, during the 10-day simulation periods; and (9) The changes in the soil thermal and hydraulic environments are most rapid in the sand soil, followed by the loam soil and the clay soil. (Lantz-PTT)
W88-04598

MODEL FOR HYSTERETIC CONSTITUTIVE RELATIONS GOVERNING MULTIPHASE FLOW. 1. SATURATION-PRESSURE RELATIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. C. Parker, and R. J. Lenhard.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2187-2196, December 1987. 4 fig, 2 tab, 30 ref. EPA Contract No. CR-812073.

Descriptors: *Hysteresis, *Soil water, *Groundwater, *Hydrologic models, *Infiltration, *Saturation, Multiphase flow, Model studies, Groundwater movement, Porous media, Mathematical models, Air-water interfaces.

A general theoretical model is presented for the description of functional relationships between relative permeability k, fluid saturation S, and pressure P in two- or three-phase (e.g., air-water or air-oil-water) porous media systems subject to arbitrary saturation paths. A parametric description of hysteretic S-P relations is developed that includes effects of air and oil phase occlusion or 'entrapment' during imbibition. Entrapped nonwetting fluid saturations at a given point along a saturation path are linearly interpolated between endpoints of primary imbibition scanning curves using maximum trapped saturations. Arbitrary order scanning curves are predicted using an empirical interpolation scheme coupled with a scaling procedure which simplifies computations and minimizes the parametric complexity of the model. All model parameters are defined in terms of measurements which may be obtained from two-phase systems (air-water, air-oil, oil-water). Extension to three-phase systems is based on the assumption that fluid entrapment processes in three phase systems are similar to those in two-phase systems and that wettability decreases in the order: water to oil to air. (See also W88-04601) (Author's abstract)
W88-04599

MODEL FOR HYSTERETIC CONSTITUTIVE RELATIONS GOVERNING MULTIPHASE FLOW. 2. PERMEABILITY-SATURATION RELATIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
R. J. Lenhard, and J. C. Parker.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2197-2206, December 1987. 8 fig, 1 tab, 25 ref. EPA Contract No. CR-812073.

Descriptors: *Hysteresis, *Soil water, *Groundwater, *Hydrologic models, *Infiltration, Saturation, Multiphase flow, Model studies, Groundwater movement, Porous media, Mathematical models, Air-water interfaces.

A theoretical model is described for the prediction of relative permeability-saturation (k-S) relations in two-phase (air-water) and three-phase (air-oil-water) porous media systems subject to arbitrary saturation paths. Integral expressions for air, water, and oil relative permeabilities are presented which extend the nonhysteretic relative permeability model of Parker to accomodate effects of pore blockage by air trapped in water and oil phases and oil trapped in the water phase. The parametric model for saturation-pressure (S-P) relations and fluid entrapment of part 1, is employed in the integral equations to enable derivation of closed-form expressions for air, water, and oil relative permeabilities as functions of current fluid saturations and saturation history. Three-phase k-S relations are calculated for main drainage and imbibition paths for a hypothetical soil to illustrate usage of the model and to evaluate the magnitude of fluid entrapment effects on relative permeabilities. Water permeability-saturation relations are predicted to exhibit mild hysteretic effects except at high saturations, while hysteresis in air permeability-saturation relations is much more pronounced. Predicted hysteresis in oil permeability is low at low water saturations but becomes quite marked as water saturation increases. Predictions of k-S-P relations for a hypothetical NAPL contamination scenario are presented using model parameters determined for a sandy soil by two methods in part 1. The results indicate that hysteresis and nonwetting fluid entrapment effects on k-S-P relations may be quite substantial. Sensitivity to calibration method is rather small. (See also W88-04600) (Author's abstract)
W88-04600

INFILTRATION JOINING PROBLEM,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2239-2245, December 1987. 1 fig, 2 tab, 23 ref.

Descriptors: *Infiltration, *Mathematical analysis, *Soil water, *Groundwater recharge, Heterogeneity, Soil properties, Permeability coefficient, Sorptivity, Mathematical equations, Mathematical studies.

Since the 1950s there has been continuing interest in the problem of joining the intermediate-time series solution for one-dimensional infiltration and the large time traveling wave solution. In practical field terms, however, observational errors, and errors produced by minor heterogeneities and nonuniformities of initial moisture content, will be far larger than the errors of even the crudest joining technique. The practical problem therefore warrants only the minimum number of parameters and maximum simplicity. For soils which are initially relatively dry, two parameters suffice, and these are ideally taken as the physically meaningful and measurable sorptivity S and hydraulic conductivity K sub 1. Polynomial fractions are unsuitable; piecewise representation is simple and adequate for most purposes, but a technique using the Knight infiltration solution of Burger's equation gives greater accuracy. It is well suited when a continuous representation and/or accuracy is desired. (Author's abstract)
W88-04604

LONG-TERM POLLUTANT DEGRADATION IN THE UNSATURATED ZONE WITH STOCHASTIC RAINFALL INFILTRATION,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04605

ANNUAL CARBON DIOXIDE CYCLE IN A MONTANE SOIL: OBSERVATIONS, MODELING, AND IMPLICATIONS FOR WEATHERING,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
D. K. Solomon, and T. E. Cerling.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2257-2265, December 1987. 11 fig, 25 ref. DOE Contract No. DE-AC05-840R21400.

Descriptors: *Carbon dioxide, *Montane soils, *Weathering, *Soil chemistry, Soil properties, Erosion, Model studies, Seasonal variation, Snow, Geochemistry, Utah.

Profiles of CO2 concentrations in soil and snow, soil respiration, soil and snow temperatures, and shallow groundwater chemistry were monitored from March 1984 to July 1985 in a montane region near Brighton, Utah. Significant seasonal variations in the concentrations of CO2 in soil and snow occurred, and two principal rise-decline cycles were observed. During the first cycle the concentration of soil CO2 at 35 cm rose from 4200 parts per million by volume (ppmv) in July to a maximum of 12,400 ppmv in August and then declined to 4300 ppmv by October. This cycle is attributed to the changing production rate of soil CO2 during the growing season. During the second cycle the concentration of CO2 at 35 cm began to rise in November, reached a maximum of 7200 ppmv in early spring, and quickly declined to 3200 ppmv by late spring shortly after the snow cover had melted. This cycle is attributed to deterioration in the exchange of CO2 between the soil and atmosphere due to a deep snowpack. A model based on Fick's second law of diffusion was developed to account for the temporal and spatial distribution of soil CO2. The model predicts that soil CO2 at 35 cm is increased by as much as 15 times due to the deep snowpack. The elevated concentration of soil CO2, abundance of water, and above-freezing soil temperatures imply that significant soil weathering occurs during the winter in montane regions. (Author's abstract)
W88-04606

HYDROLOGIC SIMILARITY. 2. A SCALED MODEL OF STORM RUNOFF PRODUCTION,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04607

FREEZING AND THAWING OF SOILS AND PERMAFROST CONTAINING UNFROZEN WATER OR BRINE,
Alaska Univ., Fairbanks. Geophysical Inst.
T. E. Osterkamp.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2279-2285, December 1987. 2 fig, 31 ref, append.

Descriptors: *Soil water, *Mathematical analysis, *Permafrost, *Brines, *Freeze-thaw tests, Soil properties, Soil temperature, Ice, Artificial islands.

When freezing or thawing occurs in natural systems, such as pure water and coarse-grained soil or permafrost, the phase change proceeds with the latent heat liberated or absorbed at a sharply defined phase boundary at a fixed temperature. However, frozen fine-grained soils and permafrost may contain significant amounts of unfrozen water or brines (or both) produced by soil particle effects or salty pore water. Freezing or thawing in these soils results in a partially frozen system consisting of soil, air, ice, and unfrozen water or brine coexisting in thermal equilibrium. The amount of brine coexisting with ice in subsea permafrost at -10 C (an extreme example) can exceed 25% of the thawed water content. For soils containing significant amounts of unfrozen water or brine, phase change and the liberation or absorption of latent heat occurs over an extended temperature range. An analytical solution is presented which divides the partially frozen soil into layers, each with constant thermal properties and with fixed temperatures at the layer boundaries which move with time in a multiple moving boundary problem. Solutions are obtained for the positions of the layer boundaries and for the temperature distribution within each layer. The theory is used to predict the maximum depth of ice penetration and the temperature profile in a large artificial island. Maximum ice penetration in the island is greater than that determined from the two-layer Neumann solution. Predicted temperature profiles are relatively smooth and do not exhibit a sharp break at the phase boundary. The solution procedure is also applicable to other heat conduction problems in permafrost containing unfrozen water or brine. (Lantz-PTT)
W88-04608

TIME TO PONDING: COMPARISON OF ANALYTIC QUASI-ANALYTIC, AND APPROXIMATE PREDICTIONS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
P. Broadbridge, and I. White.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2302-2310, December 1987. 7 fig, 43 ref. Australian Water Research Council Grant No. 84/157.

Descriptors: *Ponding, *Rainfall-runoff relationships, *Infiltration, *Mathematical analysis, Mathematical models, Hydraulic properties, Permeability coefficient, Sorptivity, Rainfall.

An analytic expression for time to ponding is introduced using the nonlinear model of Broadbridge and White. The hydraulic properties of this model can encompass properties ranging from those of a highly nonlinear Green-Ampt-like soil to those satisfying the weakly nonlinear Burgers' equation. Because of its versatility, this analytic solution is used as a benchmark against which extant analytic, quasi-analytic, and approximate expressions are compared. Time to ponding is parameterized here in terms of the readily measured field properties, sorptivity and hydraulic conductivity. In the limit of Green-Ampt-like properties the analytic solution reduces exactly to the Parlange and Smith approximation. A similar functional dependence of time to ponding on rainfall rate is found from quasi-analytic approximations. Based on this, a modified approximation is suggested which should give time to ponding for most soils to within + or - 10%. Some existing approximations are found to have unacceptable deviatio from the analytic solution, and their continued use appears unwarranted. Finally, the field problem of predicting time to ponding at any antecedent water content is addressed, given sorptivity measured at only one initial water content. (Author's abstract)
W88-04611

UPPER AND LOWER BOUNDS OF THE PONDING TIME FOR NEAR CONSTANT SURFACE FLUX,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
J. F. Boulier, J. Y. Parlange, M. Vauclin, D. A. Lockington, and R. Haverkamp.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1424-1428, November-December 1987. 19 ref.

Descriptors: *Ponding, *Soil water, *Infiltration, *Mathematical analysis, *Rainfall-runoff relationships, *Fluctuations, Theoretical analysis, Rainfall rate, Mathematical studies.

Upper and lower bounds on the relation between the time course of cumulated infiltration into soil and water content at the soil surface are derived. These estimates can be used specifically to predict upper and lower bounds of the ponding time. The analytical results are derived for mildly varying surface flux. However, the accuracy of the limits is illustrated and discussed for Grenoble sand with constant rainfall rates only. A numerical solution is also obtained that yields results outside the range of the more accurate analytical results. This confirms that errors are introduced in the numerical scheme during the early stages of infiltration. Less accurate, but easier to apply, analytical limits are also presented and discussed. (Author's abstract)
W88-04628

SOLUTIONS FOR TRANSPORT OF TWO SORBED SOLUTES WITH DIFFERING DISPERSION COEFFICIENTS IN SOIL,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. N. Angelakis, T. N. Kadir, and D. E. Rolston.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1428-1434, November-December 1987. 3 fig, 1 tab, 20 ref.

Descriptors: *Solute transport, *Soil water, *Mathematical analysis, *Path of pollutants, *Fate of pollutants, Laplace equation, Diffusion, Kinetics, Adsorption, Mathematical equations, Solutes.

Simultaneous transformation and transport in the soil of two solutes with different dispersion coefficients were described by two, one-dimensional linear partial differential equations. Linear, equilibrium adsorption-desorption relationships for both solutes and irreversible microbial first-order kinetics as an overall transformational mechanism were assumed. Consecutive analytical solutions were developed using Laplace transforms for zero initial concentrations, pulse input conditions and semi-infinite media. Special cases in which the first solute moved only by mass flow and both solutes described by the same dispersion coefficient were considered. Sample problems to demonstrate the applicability of the solutions and their sensitivity to dispersion coefficients of both solutes are presented. Computed concentration profiles of the first or second solute are sensitive to their respective dispersion coefficient, especially under low degree of adsorption of both species. The sensitivity of the concentration profiles of the second solute to the dispersion coefficient of the first species occurs, however, only under a low degree of adsorption and low decay rates of that species. (Author's abstract)
W88-04629

SOLUTE TRANSPORT IN UNDISTURBED COLUMNS OF AN AGGREGATED TROPICAL SOIL: PREFERENTIAL FLOW EFFECTS,
Florida Univ., Gainesville. Dept. of Soil Science.
M. S. Seyfried, and P. S. C. Rao.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1434-1444, November-December 1987. 11 fig, 3 tab, 53 ref.

Descriptors: *Leaching, *Nutrient loss, *Soil porosity, *Solute transport, *Aggregates, *Soil water, *Groundwater movement, Tropical regions, Mathematical analysis, Graphical analysis, Permeability coefficient, Rainfall, Dyes, Mathematical models, Convection, Tritium, Interstitial water, Solutes.

Solute breakthrough curves (BTC) resulting from miscible displacement of 3-H2O in undisturbed soil columns under a range of soil-water tensions were evaluated in terms of the mobile-immobile (MIM) water model and the convective-dispersive (CD) model. The BTC performed under tensions > 0.1 kPa were approximately symmetric in shape and accurately described by the CD model, whereas BTC performed under tensions of 0 or 0.1 kPa were quite asymmetric and better described by the MIM model. Application of tension resulted in about a 10- to 20-fold decrease in hydraulic conductivity (K(theta)) with relatively little change in soil-water content (theta). Highly asymmetric BTC were attributed to bypassing or preferential flow along macropores. Thus, in terms of model selection, bypassing was significant only when soil water contents were at or very near saturation. Rhodamine B dye patterns obtained under saturated conditions showed that soil water flow (and thus convective transport) was confined to small regions within the columns. However, easily identifiable, discrete channels were not observed in these regions. It appears that flow was conducted via a series of relatively large pores, or continuous pore sequences. Application of tension appears to have disconnected the most rapidly conducting pore sequences, reducing the asymmetry in measured BTC and compressing the dye 'solute front'. Even so, dye patterns showed that flow was very heterogeneous, as was also evidence by high dispersion coefficients in the 3-H2O experiments. Comparison of the frequency distribution of field-measured saturated hydraulic conductivity values and measured rainfall intensities indicated that saturated conditions, and hence significant bypassing, are not expected to occur in this soil under field conditions. Observations of water table response to rainfall events supports this conclusion. From these experiments, it is concluded that field-scale models based on the CD model may adequately represent solute movement in soil at this field site. (Author's abstract)
W88-04630

ORGANIC COMPOUND EFFECTS ON SWELLING AND FLOCCULATION OF UPTON MONTMORILLONITE,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
S. Chen, P. F. Low, J. H. Cushman, and C. B. Roth.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1444-1450, November-December 1987. 10 fig, 37 ref. DOE Grant No. DE-FG02-85ER60310.

Descriptors: *Organic compounds, *Montmorillonite, *Clays, *Flocculation, *Path of pollutants, *Porous media, *Soil moisture retention, Solute transport, Permeability coefficient, Ionization, Dioxane, Phenol, Acetic acid, Sodium acetate.

The swelling and shrinking and flocculation and deflocculation of clays is of fundamental importance in the transport of solutes through a porous medium because these processes affect the permeability of the medium. Since organic solutes frequently occur in toxic wastes, an investigation was conducted into the effect of eight soluble organic compounds, representing different kinds of structures and functional groups, on the swelling and flocculation of sodium saturated Upton montmorillonite. These compounds were ethanol, 1,4-dioxane, phenol, urea, benzamide, ethylamine hydrochloride, acetic acid, and sodium acetate. In general it was found that increases in the concentration of the compounds that ionize in water decreased swelling and increased flocculation to a greater extent than those that remained un-ionized, i.e., electrically neutral. However, 1,4-dioxane was exceptional in that, despite its electrical neutrality, it reduced swelling and increased flocculation significantly. Possible reasons for the effects of the different compounds on swelling and flocculation were advanced. (Author's abstract)
W88-04631

MECHANISM BY WHICH ORGANIC LIQUIDS INCREASE THE HYDRAULIC CONDUCTIVITY OF COMPACTED CLAY MATERIALS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, and J. C. Thomas.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1451-1459, November-December 1987. 6 fig, 3 tab, 18 ref. EPA Contract No. CR-808824-030.

Descriptors: *Organic compounds, *Clays, *Permeability coefficient, *Soil properties, *Path of pollutants, Flocculation, Solute transport, Soil moisture retention, Electrical properties.

The ability of concentrated organic chemicals with low dielectric constants (E) to increase the hydraulic conductivity of compacted soils has been well documented. This study was undertaken to evaluate a mechanism by which these increases occur. Theory predicts that the spacing between adjacent clay particles diminishes as the E value decreases. Hydraulic conductivity measurements were made in fixed wall permeameters with a range of concentration of organic liquids in water. Marked increases in hydraulic conductivity occurred at concentrations above which the clay flocculated. Smectite d spacings increased when the clay was equilibrated with acetone and ethanol solutions having E values ranging from 64 to 77, but decreased when equilibrated with solutions having E values < 35 to 50 as compared to that in water. All three clays tested exhibited reductions in electrophoretic mobility (mu) and the absolute value of the zeta potential which would be associated with flocculation at low E values. Relative clay content measurements indicated that all three soils flocculated in solutions with low E values. At E values >49, all clays remained dispersed. When bulk samples were exposed to organic liquids, the volume changes were proportional to the E values of the permeant. The results indicate that when organic liquids or salts are sufficiently concentrated, soil particles will be drawn closer together until the clays flocculate. Thus, changes in the surface electrical properties of the clays cause shrinkage, resulting in cracking and increases in hydraulic conductivity. Flocculation tests and E values may be used as tools to predict the influence of a solution on the hydraulic conductivity of compacted soils. (Author's abstract)
W88-04632

KINETICS AND MECHANISMS OF POTASSIUM RELEASE FROM SANDY MIDDLE ATLANTIC COASTAL PLAIN SOILS,
Delaware Univ., Newark. Dept. of Plant Science.
M. C. Sadusky, D. L. Sparks, M. R. Noll, and G. J. Hendricks.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1460-1465, November-December 1987. 5 fig, 4 tab, 55 ref.

Descriptors: *Kinetics, *Potassium, *Leaching, *Soil properties, *Solute transport, Coastal plain, Chemical reactions, Sand, Soil chemistry.

Kinetics of K release were investigated on a Kenansville loamy sand (loamy, siliceous, thermic Arenic Hapludults), a Rumford loamy sand (coarse-loamy, siliceous, thermic Typic Hapludults), and a Sassafras fine sandy loam (fine-loamy, mixed, mesic Typic Hapludults) from the Delaware Coastal Plain. Previous field experiments had shown that corn (Zea mays L.) grown on these soils did not respond to K applications. The soils contained high levels of total K ranging from 22.5 to 46.5 cmol/kg. Most of the total K was in the mineral form, particularly feldspars, and was contained in the sand fractions of the soils. Kinetics of K release from the whole soils and from the coarse, medium, and fine sand fractions were studied using a H-saturated resin and 0.01 M oxalic acid. Potassium release from the whole soils, using the resin, ranged from 0.172 to 0.251 cmol/kg over a 30-d period, and significantly more K was released with the resin than with oxalic acid. The K release that occurred from the sand fractions was attributed to the highly weathered nature of the K-feldspars in these soils as observed by electron microbeam analyses. The mechanism of K release from the soil feldspars appears to be a surface-controlled reaction. (Author's abstract)
W88-04633

ADSORPTION AND OXIDATION OF PHENOLIC COMPOUNDS BY IRON AND MANGANESE OXIDES,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W88-04634

SIMPLE KINETIC FRACTIONATION OF REACTIVE ALUMINUM IN SOIL 'SOLUTIONS',
Vermont Univ., Burlington. Dept. of Physics.
For primary bibliographic entry see Field 5B.
W88-04635

KINETIC STUDY OF CITRATE EFFECTS ON ORTHOPHOSPHATE SOLUBILITY IN AN ACIDIC, MONTMORILLONITIC SOIL,
Ohio State Univ., Columbus. Dept. of Agronomy.
S. J. Traina, G. Sposito, G. R. Bradford, and U. Kafkafi.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1483-1487, November-December 1987. 7 fig, 14 ref.

Descriptors: *Kinetics, *Citrate, *Montmorillonite, *Soil chemistry, *Orthosphosphates, Aluminum, Organic acids, Phosphates, Chemical precipitation, Chemical reactions.

Previous studies by the authors on the effects of pH, organic acids, ionic strength, and Ca on residual orthophosphate solubility in an acidic montmorillonitic soil (Typic Chromoxererts) were extended to include the variation of reaction time. The objective of the experiments was to determine the time dependence of the reactions and to elucidate further the mechanism of orthophosphate solubility in a montmorillonitic soil separate containing exchangeable Al and added citric acid, and suspended in 20 mol NaCl/cu m. In the absence of added organic acids, soluble orthosphosphate and Al(3+) activities were found to be consistent with the presence of an amorphous hydroxy-Al-phosphate solid at elapsed t> or = 24 hr. Initial citrate concentrations of 10, 100, and 400 mmol/cu m resulted in citrate sorption by the soil separate and an increase in soluble orthophosphate and Al for t < or = 1 hr. Citrate sorption continued throughout the time course of the experiments. For 1 < t < 8 hr, orthophosphate solubility was not affected by the initial citrate concentration. For 8 < t < 26 hr, orthosphosphate solubility decreased to constant levels. Soluble Al decreased for 1 < t < 30 hr and then remained constant in the 10 and 100 mmol citrate/cu m treatments. The samples reacted with 400 mmol citrate/cu m exhibited a steady increase in soluble Al for the same time period. The time-dependent changes in aqueous orthophosphate and Al were consistent with a previously proposed reaction describing organic ligand-induced formation of an insoluble hydroxy-Al-phosphate. The time trends in the solution concentrations of Ca and Si were not affected by the addition of organic ligands nor were they related to the changes in soluble Al or orthophosphate. (Author's abstract)
W88-04636

MOVEMENT OF MANGANESE-54 IN CALCAREOUS SOILS AS AFFECTED BY LEACH-

ING SOLUTION, LIME CONTENT, SALINIZATION, AND STERILIZATION,
Iraqi Atomic Energy Commission, Baghdad. Nuclear Research Center.
For primary bibliographic entry see Field 2K.
W88-04637

MODELS TO PREDICT WATER RETENTION IN SEMIARID SANDY SOILS,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
T. P. Meng, H. M. Taylor, D. W. Fryear, and J. F. Gomez.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1563-1565, November-December 1987. 6 tab, 18 ref.

Descriptors: *Hydrologic budget, *Soil moisture retention, *Semiarid lands, *Sands, Soil water, Statistical models, Organic matter, Soil properties, Matric potential, Erosion.

This research was conducted to: (i) develop statistical models for predicting water content at three matric potentials, using three levels of input data; (ii) compare predictive capability of the locally calibrated models with those of three published models; and (iii) illustrate the changes that occur in water retention when texture of sandy soils is altered by deep plowing or wind erosion. At -10 kPa, accuracy of predicting gravimetric water contents increased with increased number of inputs. The R-squared s and the slopes between predicted and measured water contents for 50 samples increased, and the intercepts came closer to zero as the inputs progress from clay only to soil texture plus organic matter and CaCO3 and on to sand separates plus texture, organic matter, and CaCO3. At the -33- and -1500-kPa matric potentials, the clay-only model predicted soil-water content equally as well as the two local models with more inputs. A previously published clay-only model that had been calibrated using semiarid soils performed almost as well as the locally calibrated models. Two other published models performed unsatisfactorily in predicting water retention at any of the matric potentials. Deep plowing increased clay content of one specific soil from 4 to 14%. Wind erosion subsequently reduced clay to 6% after 5 yr. Predicted water contents were 0.281, 0.341, and 0.293 kg/kg, respectively, at -10 kPa, and 0.012, 0.050, and 0.020 kg/kg, respectively, at -1500 kPa. (Author's abstract)
W88-04640

INTERRILL SOIL EROSION PROCESSES: I. EFFECT OF SURFACE SEALING ON INFILTRATION, RUNOFF, AND SOIL SPLASH DETACHMENT,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
For primary bibliographic entry see Field 2J.
W88-04641

INTERRILL SOIL EROSION PROCESSES: II. RELATIONSHIP OF SPLASH DETACHMENT TO SOIL PROPERTIES,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
For primary bibliographic entry see Field 2J.
W88-04642

SHRINKAGE CURVE INDICES TO QUANTIFY CULTIVATION EFFECTS ON SOIL STRUCTURE OF A VERTISOL,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Soils
D. McGarry, and I. G. Daniells.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1575-1580, November-December 1987. 2 fig, 3 tab, 25 ref.

Descriptors: *Soil water, *Soil shrinkage, *Soil structure, *Cultivation, *Soil porosity, *Vertisols, Graphical analysis, Soil dynamics, Soil moisture retention.

Differences in selected parameters and derived variables of models fitted to soil shrinkage curves were used to investigate soil structural degradation of an irrigated Pellustert in northern New South Wales, Australia. Significant differences between clods taken from the same depths in land prepared for cotton (Gossypium hirsutum L.) when 'dry' and 'wet' were found in specific clod volume at zero water content, the slope of the line in the normal shrinkage zone, the air-filled specific pore volume throughout normal shrinkage, and the range in water content in the structural shrinkage zone. These indicators showed that this soil prepared wet exhibited increased bulk density, decreased porosity, loss of structural pores, and tended to have weak structural development. (Author's abstract)
W88-04643

MACROPOROUS INFILTRATION AND REDISTRIBUTION AS AFFECTED BY EARTHWORMS, TILLAGE, AND RESIDUE,
Agricultural Research Service, St. Paul, MN.
J. E. Zachmann, D. R. Linden, and C. E. Clapp.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1580-1586, November-December 1987. 5 fig, 3 tab, 23 ref.

Descriptors: *Infiltration, *Earthworms, *Tillage, Soil water, Corn, Soil structure, Infiltration rate, Infiltration capacity, Soil chemistry, Soil properties, Bromides, Tracers.

The objectives of this study were to determine if burrows produced by two species of earthworms (Aporrectodea tuberculata and Lumbricus rubellus) found in continuous corn (Zea mays L.) in Minnesota altered the infiltration rate and depth distribution of surface applied water. Each species was introduced (212/sq m) to in situ cylinders in plots initially void of worms that had been subjected to tillage with and without residue or no-till with and without residue for 5 yr. Burrows produced by both species of worms during a 46-day period increased average infiltration rates of 30 mm of water relative to controls after 46-days. Surface residues more than doubled the number of burrows open to the surface relative to incorporated residues (48 vs. 15 for L. rubellus, 37 vs. 15 for A. tuberculata). Cocoon production, an indicator of potential survivability, was present for both species in the no-till surface residue treatment and for A. tuberculata also in the till-incorporated residue treatment. Bromide (Br(-)) tracer and mass balance for Br(-) in all treatments showed infiltration and Br(-) movement in the upper 5 cm of the profile was fastest in tillage treatments with worms and residues and that Br(-) movement beyond 19 cm was greatest for the no-till treatments with worms and residues. Pore continuity and survival potential for worms in the no-till-residue treatment suggest that this treatment might increase populations of worms in cropland while altering the hydraulic status and erosion susceptibility of soils in the north central USA. (Author's abstract)
W88-04644

PHYSICAL PROPERTIES OF A TYPIC HAPLAQUOLL UNDER CONVENTIONAL AND NO-TILLAGE,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
J. L. B. Culley, W. E. Larson, and G. W. Randall.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1587-1593, November-December 1987. 6 fig, 2 tab, 37 ref.

Descriptors: *Soil physical properties, *Soil type, *Tillage, *Soil water, *Corn, Soil moisture retention, Permeability coefficient, Crop yield, Soil porosity, Soil structure, Flow profiles, Groundwater movement.

Conservation tillage, particularly no-till (NT), for corn (Zea mays L.) production on poorly drained soils in the U.S. Corn Belt often produces lower yields. Cone index (CI), bulk density (rho sub b), shrinkage, hydraulic conductivity (K sub s), and water release characteristics were all measured in a Typic Haplaquoll under NT and conventional tillage (CN) to characterize soil physical factors possibly related to the lower yields. Measurements in the interrows indicated that wheel traffic, associated only with crop establishment (planting and herbicide spraying), eliminated the benefits of lower CI and greater K sub s associated with primary and secondary tillage. Cone index was a more sensitive indicator of these trafficking effects than was rho sub b. With the exception of the surface layer (0.0-0.1 m) of untracked interrows, K sub s values under NT, as measured in vertically oriented soil cores, exceeded those in CN profiles. Because these tillage effects were not observed when K sub s was measured in situ using a permeameter that integrated horizontal and vertical components of K sub s, the high K sub s measurements from cores were probably produced by flow in vertically oriented macropores although interfacial flow between sample ring and soil cannot be discounted. Untracked NT and CN surface layer macroporosities amounted to 5 and 0% of total porosity, respectively. Macropores did exist below the surface of the tilled layer, but they were susceptible to destruction by wheel traffic. However, tillage did not affect tile drain performance. (Author's abstract)
W88-04645

INTERMITTENT EVAPORATION FROM SOIL COLUMNS AS AFFECTED BY A GEL-FORMING CONDITIONER,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W88-04646

PHOSPHORUS REDISTRIBUTION FROM CULTIVATED FIELDS INTO RIPARIAN AREAS,
North Carolina Agricultural Research Service, Raleigh.
For primary bibliographic entry see Field 5B.
W88-04647

SOIL-WATER REGIMES OF A TYPIC HAPLAQUOLL UNDER CONVENTIONAL AND NO-TILLAGE,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
J. L. B. Culley, W. E. Larson, R. R. Allmaras, and M. J. Shaffer.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1604-1610, November-December 1987. 5 fig, 3 tab, 35 ref.

Descriptors: *Soil water, *Soil types, *Tillage, *Simulation analysis, Computer models, Hydrologic budget, Soil physical properties, Soil structure, Soil moisture retention, Bromides, Ponding, Soil porosity, Tracers, Chromatography, Permeability coefficient.

Computer simulation models are needed to help describe the dynamic nature of soil-water regimes. A simple water budget and an integrated soil-plant-atmosphere simulation model (NTRM) were each evaluated for predicting water regimes under no-till (NT) and conventional tillage (CN) of a well-structured soil. Estimates of soil physical properties related to the retention and movement of water, which were required as input for the models, were obtained from laboratory measurements on undisturbed soil cores. An in situ drainage experiment, using Br(-) labeled water, also provided information on field capacity water retention properties. Ponded water containing Br(-) moved rapidly through the surface 0.5-m profiles of both tillage treatments. Redistribution of the added water was effectively completed within about 8 hr. Field capacity matric potentials of both profiles were above -6 kPa. Chromatography theory indicated that the labeled water may have mixed with only 43 and 25% of the initial soil water in the Cn and NT profiles, respectively. Despite these observations, both models, which assumed complete mixing within each soil layer, were reasonably satisfactory at predicting soil-water contents under corn (Zea mays L.) through the 1984 growing season at a southern Minnesota location. Output from the NTRM model agreed better with experimental data showing water contents lower under CN than NT. (Author's abstract)

W88-04648

PARTICLE SIZE OF INTERRILL-ERODED SEDIMENTS FROM HIGHLY WEATHERED SOILS,
Georgia Univ., Athens. Dept. of Agronomy.
For primary bibliographic entry see Field 2J.
W88-04649

IMPACTS OF ACID ATMOSPHERIC DEPOSITION ON WOODLAND SOILS IN THE NETHERLANDS: I. CALCULATION OF HYDROLOGIC AND CHEMICAL BUDGETS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 5C.
W88-04651

MICROBIAL REDUCTION OF STRUCTURAL IRON(III) IN SMECTITES,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 2J.
W88-04654

MATHEMATICAL MODEL OF THE SECONDARY RECOVERY PROCESS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W88-04932

SIMULATION OF SURFACE RUNOFF AND PIPE DISCHARGE FROM AN AGRICULTURAL SOIL IN NORTHERN SWEDEN,
Sveriges Lantbruksuniversitet, Uppsala.
P. E. Jansson, and A. Gustafson.
Nordic Hydrology NOHYBB, Vol 18, No. 3, p 151-166, 1987. 11 fig, 22 ref.

Descriptors: *Rainfall-runoff relationships, *Soil water, *Surface runoff, *Pipe flow, *Agricultural soil, *Model studies, *Agricultural runoff, *Sweden, Runoff, Flow discharge, Meteorological data, Frost, Soil properties, Frozen ground, Model testing.

In order to test the ability of a physically based water and heat model to predict surface runoff and pipe discharge, adaptations were made to an agricultural field in northern Sweden. A five-year period was selected, including observations of meteorological data, frost in the soil, and discharge. Basic model requirements on soil properties, i.e., the water retention curve and the saturated hydraulic conductivity, were available from a previous investigation. Unsaturated conductivity was estimated from the water retention curve and by assuming a substantial influence of macro pores in the subsoil. Snow properties and thermal soil properties were adjusted to obtain a reasonable agreement with observed frost depths for areas with barley and with grass leys. Surface runoff was the dominating part of the total runoff, especially during conditions of frozen soil. The simulated discharge agreed well with the general partitioning between surface and pipe discharge but discrepancies occurred in their temporal patterns. A probable explanation of these discrepancies was that the model did not account for the enhanced spatial heterogeneity in water flow through snow and in partially frozen soil. (Author's abstract)
W88-05045

HYDRAULIC CONDUCTIVITY OF CONTAMINATED NATURAL CLAY DIRECTLY BELOW A DOMESTIC LANDFILL,
University of Western Ontario, London. Faculty of Engineering Science.
For primary bibliographic entry see Field 5B.
W88-05054

2H. Lakes

TEMPERATURE, PH, AND CATIONS AFFECT THE ABILITY OF ESCHERICHIA COLI TO MOBILIZE PLASMIDS IN L BROTH AND SYNTHETIC WASTEWATER,
Drexel Univ., Philadelphia, PA. Dept. of Bioscience and Biotechnology.
For primary bibliographic entry see Field 5D.
W88-04506

COLONIZATION OF WOOD SUBSTRATES BY THE AQUATIC XYLOPHAGE XYLOTOPUS PAR (DIPTERA: CHIRONOMIDAE) AND A DESCRIPTION OF ITS LIFE HISTORY,
Central Michigan Univ., Mount Pleasant. Dept. of Biology.
M. G. Kaufman, and R. H. King.
Canadian Journal of Zoology CJ2OAG, Vol. 65, No. 9, p 2280-2286, September 1987. 2 fig, 6 tab, 38 ref.

Descriptors: *Aquatic animals, *Macroinvertebrates, *Streams, Larvae, Population distribution, Aquatic environment.

Xylotopus par populations were monitored in a central Michigan stream during the summer growth period by sampling two types of indigenous logs and four types of introduced wood block 'baits.' Populations of larvae in the two indigenous logs were very similar over the course of the study with regard to number of individuals, biomass accumulation, development rate, and spatial distribution within colonized areas. Populations of larvae in the wood baits followed trends in density and biomass accumulation that differed between wood types. A positive relationship of the parameters with substrate softness was observed. Populations of larvae in the introduced wood baits developed faster than those in indigenous logs, with portions of the bait-inhabiting populations apparently able to complete development during the summer. Populations in indigenous logs normally require a full year for development and the accelerated growth in the 'fresh,' introduced substrates indicates a plastic phenology that allows X. par to exploit wood of variable quality. A prerequisite for terrestrial decay in determining wood suitability for X. par is also discussed. (Author's abstract)
W88-04541

SECCHI DISK VISIBILITY, CHLOROPHYLL A AND PARTICULATE ORGANIC MATTER IN THE PONTEVEDRA ESTUARY (NW OF SPAIN) (VISIBILIDAD DEL DISCO DE SECCHI, CLOROFILA A Y MATERIA ORGANICA PARTICULADA EN LA RIA DE PONTEVEDRA (NO DE ESPANA)),
Instituto de Investigacones Pesqueras de Vigo (Spain).
For primary bibliographic entry see Field 2L.
W88-04544

EFFECTS OF LOW PH AND NICKEL ON GROWTH AND SURVIVAL OF THE SHREDDING CADDISFLY CLISTORONIA MAGNIFICA (LIMNEPHILIDAE),
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-04559

STATUS OF HEADWATER BENTHIC INSECT POPULATIONS IN AN AREA OF HIGH HYDROGEN ION AND SULFATE DEPOSITION,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 5C.
W88-04560

POLYCHLORINATED BIPHENYL-TRANSPORT RATES IN THE UPPER HUDSON RIVER, NEW YORK, 1977-83,
Geological Survey, Albany, NY.
For primary bibliographic entry see Field 5B.
W88-04561

STREAMFLOW AND VELOCITY AS DETERMINANTS OF AQUATIC INSECT DISTRIBUTION AND BENTHIC COMMUNITY STRUCTURE IN ILLINOIS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
L. L. Osborne, and E. E. Herricks.
Available from the National Technical Information Service, Springfield, VA 22161. WRC Research Report No. 183, December 1983. Final Technical Completion Report. 159 p, 29 fig, 35 tab, 76 ref. Department of Interior Project No. B-136-Ill, Matching Grant Agreement No. 14-34-0001-1219.

Descriptors: *Streamflow, *Flow velocity, *Aquatic insects, *Benthic environment, *Illinois, Species diversity, Mathematical studies, Caddisflies, Taxonomy.

Streamflow characteristics, in particular velocity and depth, control channel substrates and directly or indirectly determine how aquatic insects are distributed and benthic communities are structured. A three year laboratory and field research program has been completed evaluating how streamflow affects aquatic insects in Illinois. Field studies related benthic community structure and species composition with boundary layer Reynolds number (R*) and evaluated microhabitat selection of several insect species on hydraulically defined artificial substrates. Hydraulic calibration of substrates was completed in laboratory flume studies using a thermistor based microprobe. A laboratory artificial stream was also used to determine habitat selection of net spinning caddisflies. Results indicated selection for defined microhabitats in several aquatic insect taxa. The artificial substrates proved to be a valuable tool in defining microhabitat characteristics occupied by aquatic insects. In studies to determine instream flow requirements, measures of mean column velocity were shown to be inadequate, determination of R* was preferred. The results of this research provide water resources managers with better tools to assess microhabitat modifications produced by changes in streamflow. (Author's abstract)
W88-04699

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 1: A REVIEW OF ESTUARY HYDRAULICS AND TRANSPORT AS APPLIED TO RIVERS TRIBUTARY TO LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
K. W. Bedford, D. A. Lindsay, W. G. Mattox, and C. E. Herdendorf.
Available from the National Technical Information Service, Springfield, VA 22161. Report No. B-078-OHIO, October 1983. 262 p, 42 fig, 22 tab, 182 ref, 4 append. Department of Interior Contract No. 14-34-0001-9128.

Descriptors: *Estuaries, *Lake Erie, *Hydraulic properties, *Seiches, Mixing, Stratification, Mathematical studies, Flow profiles, Great Lakes, Storms, Storm surges, Rivers.

Storms passing over the Great Lakes, and in particular Lake Erie, cause serious problems. In addition to the obvious problems that recreational users encounter, storms, by causing storm surges and seiches, initiate dramatic and persistant water level fluctuations. These fluctuations have periods of between 3 and 14 hours depending upon location on the Lake. The result of such activity is that tidal estuary-like transport properties exist periodically in river mouths adjacent to the Lake which seriously affects water quality transport and the processes of sedimentation. The following research report is one of a four volume report series which details aspects of this estuary-like behavior. This first volume reviews estuary physics and adapts it to the Lake Erie problem. This study examines processes which lead to the extension of estuarine type mixing and circulation studies in the lower river courses entering the Great Lakes. Chapters 2, 3, and 4 contain extensive reviews of the available literature. Much attention is paid to the problems of inlet stability, estuary classification, stratification, and flow forcing. Chapter 5 examines the equations of motion for estuarine flows. Fully developed 3-D equations are presented, along with spatially simplified forms. Chapters 6 and 7 extend the work to the rivers entering Lake Erie. Specific

references are noted and simple calculations presented where possible. Finally, a study scheme is proposed. (See W88-04702 thru W88-04704) (Lantz-PTT)
W88-04701

ANALYSIS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 2: LITTORAL DRIFT PROCESSES AT ESTUARY MOUTHS - A CASE STUDY AT OLD WOMAN CREEK IN LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
K. W. Bedford, M. C. Worthy, W. G. Mattox, and C. E. Herdendorf.
Available from National Technical Information Service, Springfield, VA 22161. Project Completion Report No. B-078-OHIO, October 1983. 198 p, 40 fig, 23 tab, 36 ref, 4 append. Department of Interior Contract No. 14-34-0001-9128.

Descriptors: *Littoral drift, *Estuaries, *Old Woman Creek, *Lake Erie, *Seiches, Case studies, Sediment transport, Wind, Aquatic drift, Great Lakes, Storm surges, Storms, Rivers.

Storms passing over the Great Lakes, and in particular Lake Erie, cause serious problems. In addition to the obvious problems that recreational users encounter, storms, by causing storm surges and seiches, initiate dramatic and persistant water level fluctuations. These fluctuations have periods of between 3 and 14 hours depending upon location on the Lake. The result of such activity is that tidal estuary-like transport properties exist periodically in river mouths adjacent to the Lake which seriously affects water quality transport and the processes of sedimentation. The following research report is one of a four volume report series which details aspects of this estuary-like behavior. The second volume explores alterations in sediment transport occurring in a typical river mouth zone. This study presents an initial effort to determine the physical processes that occur at the Old Woman Creek (OWC) mouth. Littoral transport rates, seiche activity, streamflow and sediment characteristics are the most important process parameters. A bilateral approach is used to examine the littoral transport rates at OWC. The first method used is measurement of the drift accumulation over time at the jetty near OWC and to use the measurement as an estimate of the net littoral transport volume. The second method uses wind data for the same time period to hindcast waves which in turn empirically predict transport volumes. The results of the two methods are compared for similarities. (See W88-04701, W88-04703 and W88-04704) (Lantz-PTT)
W88-04702

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 3: A LATERALLY AVERAGED MODEL OF MOMENTUM AND ENERGY TRANSPORT WITH APPLICATION TO SEICHE HYDRAULICS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
K. W. Bedford, L. D. Fischer, W. G. Mattox, and C. E. Herdendorf.
Available from the National Technical Information Service, Springfield, VA 22161. Report No. B-078-OHIO, October 1983. 232 p, 20 fig, 4 tab, 39 ref, append. Department of Interior Contract No. 14-34-0001-9128.

Descriptors: *Model studies, *Seiches, *Energy transport, *Estuaries, Mathematical studies, Dispersion, Advection, Mathematical equations, Density stratification, Computer programs, Great Lakes, Storm surges, Storms, Rivers.

Storms passing over the Great Lakes, and in particular Lake Erie, cause serious problems. In addition to the obvious problems that recreational users encounter, storms, by causing storm surges and seiches, initiate dramatic and persistant water level fluctuations. These fluctuations have periods of between 3 and 14 hours depending upon location on the Lake. The result of such activity is that tidal estuary-like transport properties exist periodically in river mouths adjacent to the Lake which seriously affects water quality transport and the processes of sedimentation. The following research report is one of a four volume report series which details aspects of this estuary-like behavior. The third volume explores the effect of seiche oscillation activity on the stratification effects in a typical estuary. The river-estuary physics allow several simplifications to be made in the equations. Since the dominant transport processes occur longitudinally, momentum and energy transport need to be resolved only in the longitudinal direction. Lateral variation is minimal consequently the equations may be laterally averaged. Vertical variations, though, can be significant in this process, therefore one must leave variables in both the longitudinal and vertical directions. In summary, the equations developed embody assumptions and simplification within the scope of desired final simulation resolution. The model developed has the following characteristics; (1) Time varying velocity field; (2) Time varying water surface elevation; (3) Numerical solution capable of simulating flow direction reversals; (4) Advective-dispersive transport; (5) Longitudinal-vertical density variation; (6) Vertical density stratification; (7) Coupled solution of the Momentum and Energy Transport; and (8) Two-dimensional, longitudinal and vertical resolution. (Source code listings for the model are given in the appendix. (See W88-04701, W88-04702, and W88-04704) (Lantz-PTT)
W88-04703

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 4: THE EFFECT OF LAKE ERIE/SANDUSKY BAY SEICHE OSCILLATIONS ON THE FORMATION OF SANDUSKY BAY,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
K. W. Bedford, M. D. Prater, W. G. Mattox, and C. E. Herdendorf.
Available from the National Techincal Information Service, Springfield, VA 22161. Project Completion Report No. B-078-OHIO, October 1983. 203 p, 64 fig, 15 tab, 74 ref, 4 append. Department of Interior Contract No. 14-34-0001-9128.

Descriptors: *Model studies, *Estuaries, *Lake Erie, *Sandusky Bay, *Oscillatory waves, *Seiches, *Water level, Mathematical studies, Computer programs, Mathematical equations, Great Lakes, Storm surges, Storms, Rivers.

Storms passing over the Great Lakes, and in particular Lake Erie, cause serious problems. In addition to the obvious problems that recreational users encounter, storms, by causing storm surges and seiches, initiate dramatic and persistant water level fluctuations. These fluctuations have periods of between 3 and 14 hours depending upon location on the Lake. The result of such activity is that tidal estuary-like transport properties exist periodically in river mouths adjacent to the Lake which seriously affects water quality transport and the processes of sedimentation. The following research report is one of a four volume report series which details aspects of this estuary-like behavior. The fourth volume identifies the mode structures of Lake Erie in a typical estuary and suggests a relation between the oscillation modes and the shape of the resulting estuary. This study sought to determine if there is any correlation between high level fluctuations due to long period seiching activity and the formation of basins, Sandusky Bay in particular. This will be done in part by means of a two-dimensional finite element program to calculate periods of oscillations and relative displacement fields and by observing areas of consistent erosion. Chapter II contains a brief description of Sandusky Bay along with its history of formation. Chapter III is a brief literature review of lake and basin oscillation studies. In the fourth chapter, equations of motion used in this study are derived. In Chapter V, the finite element procedures used to formulate and solve the equations of motion are given and Chapter VI contains the results of the model applied to a nearly square test basin with theoretically known periods of oscillation. Application of the model to Lake Erie and comparison of the results to statistical analysis of water level data is done in Chapter VII. In Chapter VIII the study is continued to Sandusky Bay, with discussion of results appearing in Chapter IX. Conclusions of the study appear in Chapter X. Program listings for the model are included in an appendix. (See W88-04701 thru W88-04703) (Lantz-PTT)
W88-04704

RELIABILITY OF RESERVOIR OPERATION UNDER HYDROLOGIC UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-04766

SIMULTANEOUS CONSTRUCTION OF SINGLE-PARAMETER AND MULTIPARAMETER TROPHIC STATE INDICES,
Environmental Research Center of Kanagawa Prefecture, Yokohama (Japan).
H. Yoshimi.
Water Research WATRAG, Vol. 21, No. 12, p 1505-1511, December 1987. 6 fig, 7 tab, 14 ref.

Descriptors: *Limnology, *Trophic level, *Lakes, *Phosphorus, *Chlorophyll a, *Trophic state index, *Transparency, Secchi disks, Principal component analysis, Water quality.

The simultaneous construction method of single-parameter and multiparameter indices to evaluate trophic states for lakes utilized a principal component analysis (PCA) and data about total P, chlorophyll a, and Secchi disk transparency. The data in the analysis was for surface water (0-0.5 m) collected at 38 points in 22 lakes in Japan during the period May-October (stagnation period) in 1978-1983. For this study, some new techniques of data treatment and application of PCA were developed that made it possible to evaluate the trophic state of a lake reasonably over a broad range of each parameter and to compare the three single-parameter indices in parallel. The resulting single-parameter and multiparameter indices were evaluated by comparison with the results of Lambou et al. (Water Research 17: 1619-1626 (1983)). The multiparameter index proposed here was very effective. (Author's abstract)
W88-04851

PHYTOPLANKTON BIOMASS AND PRODUCTION IN THE RIVER MEUSE (BELGIUM),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium).Dept. of Biology.
J. P. Descy, P. Servais, J. S. Smitz, G. Billen, and E. Everbecq.
Water Research WATRAG, Vol. 21, No. 12, p 1557-1566, December 1987. 9 fig, 28 ref.

Descriptors: *Phytoplankton, *Primary productivity, Biomass, Annual runoff, River flow, Mathematical models, Meuse River, Belgium, Chlorophyll, Photosynthesis, Light saturation.

The biomass and production of the phytoplankton in a relatively unpolluted reach of the River Meuse were followed through 1983 and 1984. Chlorophyll a varied from 0.2 to about 120 mg/cu m, and production ranged between 0.05 and 5.78 g C/sq m/day. The mean photosynthetic quotient was 1.25. The parameters of the light-photosynthesis relationship (P sub opt = rate of light-saturated photosynthesis, and I sub k = onset of light saturation of photosynthesis) were calculated and related to the variations of temperature and light in the water column. A simple model allowed calculations of the annual production, which was estimated to be 494 g C/sq m/yr in 1983 and 547 g C/sq m/yr in 1984. A model was developed that explains the relationship between phytoplankton development and discharge: this model shows how the effect of discharge can be described by a 'dilution rate' of the plankton growing in the river water. (Author's abstract)
W88-04858

LABORATORY STREAM DESIGN FOR BIOLOGICAL RESEARCH,
Rural Water Commission of Victoria, Armadale (Australia). Water Quality Assessment Section.

P. A. Horne and, and G. L. Bennison.
Water Research WATRAG, Vol. 21, No. 12, p 1577-1579, December 1987. 2 fig, 9 ref. Australian Water Resources Council Project 84/168.

Descriptors: *Laboratory streams, *Microcosms, *Macroinvertebrates, *Lotic environment, Stream biota, Artificial watercourses.

A three-channel, recirculating laboratory stream system suitable for use in biological experimentation was designed. The physical factors of water flow, temperature, light, substrate, and water chemistry can be controlled individually as desired. The system was designed for use with freshwater benthic macroinvertebrates that normally inhabit rapids environments. It has been used successfully to identify preferred velocities of larval Simuliidae (Diptera). (Author's abstract)
W88-04861

DROGUE-CLUSTER AND DYE-DISPERSION MEASUREMENTS,
Gore and Storrie Ltd., Toronto (Ontario).
For primary bibliographic entry see Field 5B.
W88-04866

SURVIVAL OF SPOTTED SALAMANDER EGGS IN TEMPORARY WOODLAND PONDS OF COASTAL MARYLAND,
Patuxent Wildlife Research Center, Laurel, MD.
For primary bibliographic entry see Field 5C.
W88-04869

PLAYA LAKE BASINS ON THE SOUTHERN HIGH PLAINS OF TEXAS, U.S.A.: A HYPOTHESIS FOR THEIR DEVELOPMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W88-04912

WETLANDS OF THE CHESAPEAKE.
For primary bibliographic entry see Field 2L.
W88-04934

WETLANDS OF THE CHESAPEAKE BAY WATERSHED: AN OVERVIEW,
Fish and Wildlife Service, Newton Corner, MA.
For primary bibliographic entry see Field 2L.
W88-04936

CHESAPEAKE BAY FRESHWATER WETLANDS: STATUS AND RESEARCH NEEDS,
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Wetlands Ecology.
G. M. Silberhorn.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 25-29, 13 ref.

Descriptors: *Chesapeake Bay, *Wetlands, *Research priorities, Tide lands, Ecosystems, Nutrient cycling, Sampling, Decomposition, Sediments.

Tidal freshwater wetlands have received far less scientific investigation than saline marshes, but the available evidence suggests that the two ecosystems share similar ecological values. In particular, current literature demonstrates that tidal freshwater wetlands definitely influence both the timing and type of nutrients entering adjacent estuary systems. Because of the scarcity of studies on tidal freshwater wetlands, goal-oriented research programs are needed to increase understanding of nutrient cycling processes and plant community structure in these systems. In order to develop accurate nutrient cycling models, research projects need to address the following research gaps: (1) sampling methods that accurately and reliably estimate below ground biomass need to be developed in order to better assess total net production of wetland vegetation; (2) decomposition must be thoroughly analyzed in order to increase understanding of production-nutrient relationships; and (3) nutrient cycling research programs must consider both vegetation and sediment as contributing components to the system. (See also W88-04934) (Lantz-PTT)
W88-04937

SEDIMENTARY PROCESSES AND SEA LEVEL RISE IN TIDAL MARSH SYSTEMS OF CHESAPEAKE BAY,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W88-04939

MANAGING LANDSCAPES FOR HUMANITY AND NATURE: THE ROLE OF WETLANDS IN REGIONAL NUTRIENT DYNAMICS,
Florida Univ., Gainesville. Center for Wetlands.
For primary bibliographic entry see Field 6G.
W88-04940

ROLE OF NON-TIDAL AND TIDAL FRESHWATER MARSHES IN REDUCING NUTRIENT INPUTS IN CHESAPEAKE BAY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
W. E. Odum.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 76-83, 25 ref.

Descriptors: *Tidal marshes, *Chesapeake Bay, *Nutrients, Retention, Cycling nutrients, Peat, Wetlands, Litter, Organic matter, Hydrologic properties, Seasonal variation, Wastewater treatment.

All wetland types have the potential to intercept and retain nutrients, with the degree and extent of retention most dependent upon the wetland's hydrological characteristics and the amount of peat, surface litter, and organic matter within the soil. While tidal freshwater marshes surrounding the Chesapeake Bay theoretically should intercept and retain significant amounts of nutrients, they may not be as efficient as salt marshes due to the almost complete disappearance of plant material and litter during autumn, winter, and early spring. There is almost no data on the interception of nutrients by non-tidal freshwater wetlands and their role in the total nutrient budget of the Bay. Thus, it is essential that the role of this wetland type in nutrient removal be carefully and thoroughly investigated. This investigation recommends that: (1) Tidal freshwater marshes should be protected from alteration and destruction to the fullest extent possible. Essentially, society is receiving 'free' nutrient processing and retention with no operating costs; (2) The role of non-tidal freshwater marshes in removing nutrients which might enter Chesapeake Bay should be investigated in a careful and detailed manner; (3) It is essential that non-tidal freshwater wetlands be adequately protected until more is learned about their role in the health of the Bay; (4) The possibility of utilizing small artificial non-tidal wetlands at specific point sources of pollution along the tributaries of the Bay should be investigated; (5) Probably the most important unknown in dealing with the nutrient retention characteristics of all wetlands concerns those variables which control the degree and extent of retention. (See also W88-04934) (Lantz-PTT)
W88-04941

SUBMERGED AQUATIC VEGETATION IN THE CHESAPEAKE BAY: VALUE, TRENDS AND MANAGEMENT,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W88-04942

WETLAND HABITAT VALUES TO UPLAND WILDLIFE,
Fish and Wildlife Service, Annapolis, MD.
J. W. Gill.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 96-104, 23 ref.

Descriptors: *Wetlands, *Wildlife habitats, *Riparian land, Tidal marshes, Vegetation, Birds, Mammals, Species diversity, Habitats, Ecological distribution, Brackish water.

Riparian and tidal freshwater wetlands possess vegetative variety and an associated edge effect with adjacent forests that serve as a habitat for many birds and terrestrial mammals. Apparently, the form of wetland vegetation is more important than species composition. The degree to which an upland species uses a wetland depends upon the requirements of the particular species, availability of suitable upland habitat, and time of year. Location of a wetland, as well as location in reference to adjacent habitat, are also important. Isolation tends to reduce the habitat value for some species. Wetland size, however, is apparently not an overriding factor. The key to wetland habitat values to upland wildlife is diversity, which can supplement or take the place of a terrestrial species' habitat requirements. Wetlands provide an alternative for some upland wildlife. Brackish water wetlands, which are characterized by a more structurally homogeneous habitat, enhance diversity of wildlife by providing plentiful food and cover for upland wildlife. (See also W88-04934) (Lantz-PTT)
W88-04943

VALUES OF WETLANDS TO ENDANGERED SPECIES WITHIN THE CHESAPEAKE BAY WATERSHED: MARYLAND AND VIRGINIA COASTAL PLAIN,
Mare Nostrum Foundation, Washington, DC.
C. P. White.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 105-120, 1 fig, 4 tab, 49 ref.

Descriptors: *Wetlands, *Endangered species, *Chesapeake Bay, *Maryland, *Virginia, Species diversity, Population density, Birds, Eagles, Coastal marshes, Salt marshes, Mammals, Ecological distribution, Fish, Turtles, Pelicans, Osprey.

The 498,000 acres of tidal and nontidal wetlands in the Chesapeake basin have outstanding value to wildlife as both permanent habitat and temporary feeding and nesting grounds. Hundreds of marsh- and swamp-dwelling species inhabit the Chesapeake region, including nearly 120 different birds, 102 reptiles and amphibians, and 20 mammals. Many hundreds, even thousands, of aquatic and upland species benefit indirectly from the wetlands' hydrologic and biological (e.g., food-generating) values. Yet, only 14 animal species found within the Bay and the coastal plain sector of the Chesapeake watershed are listed by the federal government as either endangered or threatened excluding whales. Of these, the bald eagle is the only permanent breeding species, nesting adjacent to fresh- and brackish-water marshes. Several other endangered animals, including the peregrine falcon, red-cockaded woodpecker, and Delmarva Peninsula fox squirrel visit or border Chesapeake Bay wetlands, while rare and endangered fishes and sea turtles depend upon these wetlands for food and water quality benefits. Both the osprey and the eastern brown pelican have recovered on the Atlantic Coast to a stable breeding status. (See also W88-04934) (Lantz-PTT)
W88-04944

CONTRIBUTION OF WETLANDS TO ESTUARINE PRODUCTION AND FISHERIES; AN OVERVIEW WITH EMPHASIS ON CHESAPEAKE BAY,
National Marine Fisheries Service, Oxford, MD. Oxford Lab.
T. E. Goodger.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 121-128, 34 ref.

Descriptors: *Wetlands, *Estuaries, *Productivity, *Fisheries, *Chesapeake Bay, Ecosystems, Species diversity, Ecological distribution, Aquatic plants, Tidal marshes, Fish, Intertidal areas, Salt marshes, Marshes, Sea grasses.

Approximately two thirds, by weight, of the shellfish and finfish landed in this country spend at least part of their lives in estuaries. As much as 98% of the Atlantic and Gulf coast harvests are estuarine-dependent. In the Chesapeake Bay, such species as

the American oyster and white perch complete their entire life cycles within estuarine waters; others only use estuaries at certain stages of their lives. Freshwater spawning marine species, such as striped bass and American shad, and many marine spawners, such as bluefish and menhaden, depend upon estuaries as nursery and feeding areas. Tidal wetlands, particularly salt marshes, have been associated with estuarine productivity and fisheries harvest. In the Chesapeake region, where 97% of the fish harvest is estuarine-dependent, there are approximately 425,000 acres of tidal wetlands. In New England, where only 11% of the harvest is estuarine dependent, there are less than 67,000 acres of tidal wetlands. Specific contributions of other wetland habitats are discussed briefly. These habitats include: seagrass meadows (submerged aquatic vegetation; intertidal flats; regularly-flooded salt marshes; intermittently flooded marshes; tidal freshwater marshes; non-tidal freshwater wetlands; and wetlands and fisheries. (See also W88-04934) (Lantz-PTT)
W88-04945

VALUES AND FUNCTION OF CHESAPEAKE WETLANDS FOR WATERFOWL,
V. D. Stotts.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 129-142, 1 tab, 54 ref.

Descriptors: *Wetlands, *Waterfowl, *Chesapeake Bay, *Maryland, Economic aspects, Submerged plants, Aquatic plants, Geese, Bottomland, Tidewater, Mud flats, Tidal flats.

Numbers of migrating waterfowl in the Chesapeake have been declining since the mid-1950's as well as changing in composition. Several surveys of Maryland's emergent wetlands have been made since the early 1950s; surveys from 1968 indicated that about 308,000 acres of this habitat remained intact. Of this total, about 2% was non-tidal. An omission from these figures is the waters of non-tidal streams. None of these surveys has taken into account the important hardwood bottomlands along streams. These lands have been estimated to total about 355,000 acres, but 119,600 of this acreage has been subject to extensive alteration. Including these important bottomlands, a liberal estimate for total emergent wetlands within Maryland's Chesapeake basin was about 540,700 acres in 1970 (excluding coastal wetlands and bottomlands in eastern Worcester County). Open tidal waters of the Chesapeake and its tributaries also constitute a vital part of Maryland's wetlands. The most important to waterfowl are: mud flats (831 acres); 0'-6' depths of water (mlw) (399,737 acres) and 6'-12' depths of water (282,047 acres). The rest of the Bay and its tidal tributaries include 902,367 acres of open tidal waters more than 12' deep. The declines seem to parallel declines in submerged aquatic vegation (SAV) particularly for some species. Some species of geese, however, have been increasing apprarently due to adaptation to new food sources, i.e., agricultural crops and weeds. Waterfowl have high economic and social value, and measures such as improved filtration of drainage waters and reduction of shoreline erosion must be utilized to preserve remaining wetlands and the waterfowl that depend upon them. (See also W88-04934) (Lantz-PTT)
W88-04946

EFFECTS OF LAKES AND WETLANDS ON FLOODFLOWS AND BASE FLOWS IN SELECTED NORTHERN AND EASTERN STATES,
Geological Survey, Ithaca, NY.
R. P. Nivitzki.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 143-154, 3 fig, 4 tab, 9 ref.

Descriptors: *Flood flow, *Wetlands, *Lakes, *Hydrologic properties, *Mathematical equations, Mathematical studies, Base flow, Streamflow, Flow profiles, Flood peak, Drainage flow, Infiltration rate, Runoff.

Early studies illustrated the relationship between flood peaks and base flows in Wisconsin streams, and percentage of basin covered by lakes and wetlands. These investigations developed equations to estimate streamflow characteristics at any point on a stream from basin characteristics and climate factors. The streamflow characteristics analyzed included mean annual and mean monthly flows, flood peaks of selected recurrence intervals, and low flows of selected durations and recurrence intervals. The basin characteristics included drainage area, stream-channel slope, stream-channel length, basin storage (area of lakes and wetlands), basin elevation, percent forest cover, and soil-infiltration rate. Climatic factors such as rainfall intensity and distribution, snowfall, and frost penetration, also were included. The equations were developed through multiple regression techniques. Although the regression equations described are too general to calculate the influence of a particular wetland on either floodflows or base flows, they are adequate for the regional analysis of wetland influence on streamflow. Results suggest that in basins with large percentages of lakes and wetlands, (1) flood peaks are less, (2) runoff in spring is greater, and (3) base flow is less than in basins with no large or wetlands. In basins with as little as 5% lake and wetland area, flood peaks may be only half as large as those in basin with no lake or wetland area, and further losses of lakes or wetlands may significantly increase flood peaks. (See also W88-04934) (Lantz-PTT)
W88-04947

MODIFICATION OF ACID MINE DRAINAGE BY SPHAGNUM-DOMINATED WETLANDS AND THE EFFECT ON STREAM WATER QUALITY,
West Virginia Univ., Morgantown. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W88-04950

IMPACT OF AGRICULTURAL DRAINAGE ACTIVITIES IN THE COASTAL FLATS REGION OF THE CHESAPEAKE BAY,
Fish and Wildlife Service, Annapolis, MD.
For primary bibliographic entry see Field 6G.
W88-04952

MANAGEMENT OF AGRICULTURAL DRAINAGE WATER FOR WATER QUALITY,
North Carolina State Univ., Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 5G.
W88-04953

FORESTRY AND FOREST MANAGEMENT IMPACTS ON WETLANDS,
Southeastern Forest Experiment Station, Charleston, SC.
For primary bibliographic entry see Field 4C.
W88-04954

MINIMIZING ADVERSE IMPACTS ON WETLANDS OF WATER QUALITY ASSOCIATED WITH FOREST AND AGRICULTURAL PRACTICES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5G.
W88-04955

RESOURCE PROTECTION: A DELAWARE PERSPECTIVE,
Delaware State Dept. of Natural Resources and Environmental Control, Dover. Wetlands Section.
For primary bibliographic entry see Field 6E.
W88-04956

PENNSYLVANIA'S WETLANDS: URBANIZATION AND WATERCOURSE MODIFICATION,
Corps of Engineers, Beach Creek, PA. Foster Joseph Sayers Dam.
For primary bibliographic entry see Field 6E.
W88-04957

PENNSYLVANIA'S WETLAND REGULATIONS AND THE ARMY CORPS OF ENGINEERS 404 PERMITTING IN PENNSYLVANIA,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Dams and Waterway Management.
For primary bibliographic entry see Field 6E.
W88-04960

MARYLAND'S TIDAL WETLAND PROTECTION PROGRAM - PAST, PRESENT AND FUTURE,
Maryland Water Resources Administration, Annapolis.
For primary bibliographic entry see Field 6E.
W88-04962

PERMIT COORDINATION IN VIRGINIA,
Virginia Marine Resources Commission, Newport News. VA.
For primary bibliographic entry see Field 6E.
W88-04963

LOCAL CONTROL OF WETLANDS IMPACTS,
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6E.
W88-04966

LOCAL GOVERNMENT APPROACH TO WETLAND PROTECTION,
Harford County Dept. of Planning and Zoning, Bel Air, MD.
For primary bibliographic entry see Field 6E.
W88-04967

FEDERAL TAX CODE OPPORTUNITIES TO MAINTAIN WETLANDS,
Nature Conservancy, Arlington, VA.
For primary bibliographic entry see Field 6E.
W88-04968

TAX DISINCENTIVES AND OTHER FEDERAL PROGRAMS DISCOURAGING PRESERVATION OF WETLANDS,
Environmental Law Inst., Washington, DC.
For primary bibliographic entry see Field 6E.
W88-04969

MITIGATION AND ITS PROBLEMS,
Fish and Wildlife Service, Annapolis, MD.
For primary bibliographic entry see Field 6E.
W88-04970

COMPENSATING FOR WETLAND LOSSES IN THE MITIGATION PROCESS,
Environmental Concern, Inc., Michaels, MD.
For primary bibliographic entry see Field 6E.
W88-04971

VIRGINIA'S WETLAND MITIGATION/COMPENSATION POLICY: ITS EVOLUTION AND CURRENT STATUS,
For primary bibliographic entry see Field 6E.
W88-04972

VIRGINIA WETLANDS ACT AND THE FUTURE OF WETLANDS MANAGEMENT,
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Ocean and Coastal Law.
For primary bibliographic entry see Field 6E.
W88-04973

LAYMAN'S GUIDE TO THE TAKING ISSUE,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
For primary bibliographic entry see Field 6E.
W88-04974

PRIVATE PROGRAM FOR WETLANDS PROTECTION AND CONSTRUCTION: CHESAPEAKE WILDLIFE HERITAGE EXPERIENCE,
Chesapeake Wildlife Heritage, Easton, MD.
For primary bibliographic entry see Field 3F.
W88-04975

COMBINING SCIENCE AND MANAGEMENT: LOOKING AHEAD FOR CHESAPEAKE WETLANDS CONSERVATION. HOW IS THE FEDERAL, STATE, LOCAL PARTNERSHIP WORKING,
Environmental Protection Agency, Philadelphia, PA. Region III.
For primary bibliographic entry see Field 6E.
W88-04976

HOW IS THE FEDERAL, STATE, LOCAL PARTNERSHIP WORKING IN VIRGINIA,
Virginia Deputy Secretary of Resources, Richmond.
For primary bibliographic entry see Field 6E.
W88-04977

FEDERAL, STATE AND LOCAL COOPERATION IN WETLANDS PRESERVATION,
Baltimore County Office of Planning, Towson, MD.
For primary bibliographic entry see Field 6E.
W88-04978

WETLANDS PROTECTION IN CHESAPEAKE BAY REGION - WHERE WE GO FROM HERE,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
For primary bibliographic entry see Field 6E.
W88-04979

COMPARISON OF SEDIMENTATION REGIMES IN FOUR GLACIER-FED LAKES OF WESTERN ALBERTA,
Illinois Univ. at Chicago Circle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W88-05023

GLACIO-LACUSTRINE SEDIMENTATION ON LOW SLOPE PROGRADING DELTA,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-05025

LARGE LAKES OF CHINA,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
W. Y. B. Chang.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 235-249, 1987. 3 fig, 10 tab, 17 ref.

Descriptors: *Lakes, *China, *Lake characteristics, Lake morphology, Lake fisheries, Lake sediments, Water quality, Physical properties, Chemical properties, Biological properties, Fish management, Fish, Sediment loading, Sediments, Tectonics, Tibet, Ecological effects, Geologic joints.

China contains 28 of the world's large lakes (>500 sq km). Information on these lakes is considerably limited. Details on the origin, location, and the physical, chemical and biological characteristics are provided. The prevalent lake fish management methods in China are discussed. Elements which have influenced changes in Chinese large lakes are also discussed. Climatic conditions and tectonic uplift strongly influenced the large lakes in the Tibet-Qinghai-Sinkiang region while sediment loading and human impacts continue to be the major concerns for the large lakes in the Pacific basin. (Author's abstract)
W88-05028

MODELLING OF TOXIC CONTAMINANTS IN THE NIAGARA RIVER PLUME IN LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W88-05029

ENERGY RELATIONS IN CLADOPHORA GLOMERATA FROM LAKE ERIE,
State Univ. of New York Coll. at Fredonia. Dept. of Biology.
K. E. Mantai.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 279-284, 1987. 4 fig, 1 tab, 16 ref.

Descriptors: *Energy, *Algae, *Limnology, *Temperature effects, *Energy balance, *Photosynthesis, *Plant respiration, Chlorophyta, Plant physiology, Water temperature, Lake Erie, Temperature, Plant growth, Starch, Seasonal variation, Respiration.

Photosynthesis and respiration measurements were made at lake temperatures with Cladophora glomerata collected from the eastern basin of Lake Erie. Although water temperatures varied from 10 C in May to almost 25 C in July, neither photosynthesis nor respiration showed any general increase in rates, even though there were wide daily fluctuations. Starch levels were low during the period of rapid growth but then increased until the time of sloughing. Chlorophll content also declined as sloughing approached. Both photosynthesis and respiration rates did not show a general temperature-induced increase as water temperatures rose, indicating that the cells did not deteriorate due to a negative 4 energy balance. Wide day-to-day fluctuations in the rates indicate that the cells respond rapidly to environmental conditions. (Wood-PTT)
W88-05030

DYNAMICS OF LAKE MICHIGAN PHYTOPLANKTON: THE DEEP CHLOROPHYLL LAYER,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. L. Fahnenstiel, and D. Scavia.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 285-295, 1987. 7 fig, 1 tab, 30 ref.

Descriptors: *Deep water, *Deep chlorophyll layer, *Phytoplankton, *Limnology, *Temperature effects, *Lake Michigan, Plankton, Aquatic plants, Distribution patterns, Chlorophyll, Thermal stratification, Plant populations, Plant growth, Lake morphology, Species composition.

The dynamics of the Lake Michigan deep chlorophyll layer (DCL) were studied from the period of late spring isothermal mixing (May) through mid-stratification (July-August) from 1982 to 1984. After the onset of thermal stratification, the DCL developed in the 15-30 m region, and deepening to 25-50 m in July, and 40-70 m in August. Chlorophyll and phytoplankton carbon concentrations in the DCL averaged, respectively, 1.80X and 1.34X epilimnetic concentrations during early stratification (June). These factors increased to 5.70X and 2.60X during mid-stratification. Although phytoplankton carbon concentrations within the DCL changed on average only 31% from May through July-August, phytoplankton species composition exhibited pronounced shifts. Measured growth, sedimentation, and zooplankton species grazing rates suggest DCL formation was attributable to in situ growth and to a lesser extent to sedimentation and shade adaptation. By July, sedimentation resulted in a net loss from the DCL. With the deepening of the DCL during mid-stratification, the importance of in situ growth decreased while the importance of shade adaptation increased. In situ growth was only important in the upper part of the DCL. Zooplankton grazing increased during mid-stratification and was at least partially responsible for phytoplankton concentration decreases in the 20-50 m region. (Author's abstract)
W88-05031

BENTHIC MACROINVERTEBRATE ASSOCIATIONS IN RELATION TO ENVIRONMENTAL FACTORS IN GEORGIAN BAY,
Department of Fisheries and Oceans, Ottawa (Ontario).
M. G. Johnson, O. C. McNeil, and S. E. George.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 310-327, 1987. 4 fig, 4 tab, 33 ref, append.

Descriptors: *Limnology, *Lake Huron, *Benthic fauna, *Macroinvertebrates, *Benthic environment, *Bays, *Georgian Bay, Aquatic animals, Benthos, Water analysis, Sediments, Trophic level, Temperature effects, Water temperature, Oligochaetes, Midges, Organic matter, Sand, Silt, Clay, Phosphorus, Zinc, Lead, Ecosystems, Mercury, Statistical analysis.

Association analysis of data on benthic macroinvertebrates in 257 samples from Georgian Bay, followed by discriminant analysis of water and sediment characteristics, facilitated quantitative description of trophic variability within a relatively unpolluted system. Discriminating variables were: bottom water temperature; water pH and Ca; sediment organic matter; sand; silt; clay; and total P, Zn, Pb, and Hg. Four discriminating functions, accounting for 86% of variance, indicated the importance of temperature first, concentrations of organic matter and silt (with sand negative) second, and, in the third and fourth functions, water pH and Ca. Associations which occurred at cooler temperatures consisted of Pontoporeia hoyi with dominant oligochaetes and chironomids generally determined by sediment richness (organic matter and silt content primarily). The associations are specified for varying sediment richness and water temperature. Cluster analysis was used to define associations based on the numbers of benthic macroinvertebrates found in samples. Continued observations on the distribution of benthic macroinvertebrates in response to abiotic gradients in a relatively unpolluted system, should assist in interpreting observations of enriched systems where influences of natural and cultural factors are often confused. (Wood-PTT)
W88-05033

COMPARISON OF LAKE ONTARIO ZOOPLANKTON COMMUNITIES BETWEEN 1967 AND 1985: BEFORE AND AFTER IMPLEMENTATION OF SALMONID STOCKING AND PHOSPHORUS CONTROL,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5G.
W88-05034

ASSESSMENT OF THE EFFECTS OF CLIMATE WARMING ON GREAT LAKES BASIN FISHES,
Toronto Univ. (Ontario). Dept. of Zoology.
J. D. Meisner, J. L. Goodier, H. A. Regier, B. J. Shuter, and W. J. Christie.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 340-352, 1987. 3 fig, 2 tab, 93 ref.

Descriptors: *Limnology, *Great Lakes, *Water temperature, *Temperature effects, *Fish, *Air temperature, *Ecological effects, Environmental effects, Temperature, Thermal stress, Fish physiology, Habitats, Population dynamics, Fish populations, Climatology, Species diversity.

Information on the influence of temperature on the physiology and ecology of fish was combined with information on the interrelationship between climate and physical limnology, for on initial assessment of the impact of future climate warming on fish and their habitats in the Great Lakes basin. The predicted increase in mean annual air temperature of 3.2 - 4.8 C is not expected to extirpate fish taxa in the basin. Habitat warming in streams and lakes will likely shrink extant populations of salmonines and coregonines through reductions in preferred thermal habitats, and allow range extensions of cyprinids, esocids, centrarchids, and ictalurids. Competition for optimal thermal space within thermal niches will increase, resulting in changes in community composition. Relatively rapid changes in water level would adversely affect the structure of wetlands and littoral areas, reducing their efficacy as spawning and nursery

areas. Changes in yields from fisheries of preferred species are expected. (Author's abstract)
W88-05035

NEAR-BOTTOM CURRENTS AND SUSPENDED SEDIMENT CONCENTRATION IN SOUTHEASTERN LAKE MICHIGAN,
Argonne National Lab., IL. Environmental Research Div.
For primary bibliographic entry see Field 2J.
W88-05037

LARGE LAKE MODELS - USES, ABUSES, AND FUTURE,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
W. C. Sonzogni, R. P. Canale, D. C. L. Lam, W. Lick, and D. Mackay.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 387-396, 1987. 1 tab, 34 ref.

Descriptors: *Limnology, *Water management, *Mathematical models, *Hydrologic models, *Water quality management, *Model studies, *Great Lakes, Water quality, Eutrophication, Hazardous materials, Resources management.

Mathematical modeling has played and should continue to play an important role in Great Lake management and scientific development. Great Lakes modeling is entering a phase of relative maturity in which expectations are more realistic than in the past. For example, it is now realized that the modeling process itself is valuable even if the resulting models are not immediately useful for management. The major thrust in the past has been water quality (eutrophication) modeling, but there has been a recent shift toward developing toxic substances models. Modelers and model users have been limited by a lack of knowledge of Great Lakes processes, limited data availability, and incomplete or improper validation. In the future, greater emphasis is needed on specifying prediction uncertainty and conducting proper model validation - including calibration, verification, and post-audits. Among the Great Lakes modeling activities likely to have the greatest payoff in the near future are: (1) the development and refinement of toxic substances models, (2) post-auditing and improvement of eutrophication models, and (3) the adaptation of models for use on personal computers to allow greater model utilization. (Author's abstract)
W88-05038

RELATIONSHIP BETWEEN CARBON, NITROGEN AND CHLOROPHYLL A IN THE RIA OF PONTEVEDRA, NW OF SPAIN (RELACIONES ENTRE CARBONO, NITROGENO Y CLOROFILA A EN LA RIA DE PONTEVEDRA, NO DE ESPANA),
Instituto de Investigaciones Marinas, Vigo (Spain).
For primary bibliographic entry see Field 5C.
W88-05039

FORAGING CHARACTERISTICS OF CANADA GEESE ON THE NISUTLIN RIVER DELTA, YUKON,
Alberta Univ., Edmonton. Dept. of Zoology.
T. S. Coleman, and D. A. Boag.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 10, p 2358-2361, October 1987. 4 fig, 21 ref. Natural Sciences and Engineering Research Council of Canada Grant A2010.

Descriptors: *River mouth, *Geese, *Forages, *Aquatic plants, *Food habits, *Nisutlin River, *Yukon Territory, Behavior, Waterfowl, River deltas, Rhizomes, Water level, Water level fluctuations, Seasonal variation, Vegetation.

Food selection by Canada geese (Branta canadensis), staging in the autumn on the Nisutlin River delta in the south central Yukon Territory, was investigated between August and October of 1981, 1982, and 1983. Three distinct plant associations were used by the foraging geese: an aquatic association in which rhizomes of Potamogeton richardsonii, the dominant species, were eaten; a terrestrial and more vegetatively complex association in which Equisetum palustre was the main plant taken; and an association of almost pure stands of Equisetum fluviatile in wet depressions behind old river levees. Availability of these feeding zones depended on water levels on the delta. When water levels were low (October 1982), all feeding zones were available, yet the geese fed almost entirely in the Potamogeton zone, indicating a preference for that zone. At intermediate water levels, Potamogeton richardsonii was no longer available and the geese grazed on the complex vegetative zone, taking Equisetum palustre, Ranunculus reptans, and Eleocharis palustris in the ratio of their relative availability (85:10:5). Only when water levels were high did the geese graze exclusively in the Equisetum fluviatile zone, the least preferred. (Author's abstract)
W88-05048

INFLUENCE OF WATER VELOCITY ON PARTICLE CAPTURE BY THE LABRAL FANS OF LARVAE OF SIMULIUM BIVITTATUM MALLOCH (DIPTERA: SIMULIIDAE),
S. A. Braimah.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 10, p 2395-2399, October 1987. 8 fig, 2 tab, 37 ref. Natural Sciences and Engineering Research Council of Canada Grant A-5753.

Descriptors: *Water current velocity, *Larvae, *Feeding behavior, *Aquatic environment, Insects, Aquatic insects, Water currents, Velocity, Insect behavior, Insect control, Ecosystems.

Larvae of Simulium bivittatum Malloch exposed to water velocities of 3.2-47.0 centimeters/second (cm/s) consumed a maximum of particles at velocities of 10.0-25.0 cm/s. Larvae consumed significantly fewer particles at velocities below and above the suitable (10.0-25.0 cm/s) range. The inability of larvae to capture particles efficiently at low velocities (3.2-4.5 cm/s) is attributed to the formation of thick boundary layers around filtering structures (labral fans). Steep velocity gradients in the boundary layer around fans and probably high drag forces on fans, contribute to the low retention efficiency at high velocities (35.0-47.0 cm/s). The drag forces and the torque on particles at the water-fan interface enhance the adhesion of small (0.5-5.7 micrometers) particles, which form the bulk of food particles in the guts of the larvae. To insure that the rates of filtration reflect the effect of mechanisms other than seiving that are involved in the capture of particles, future studies on other filter feeders, including particles smaller than pore spaces between the filtering structures of organisms. Previous studies have dealt with the equations of filtration rates that incorporate the idea that more than one capture mechanism may operate at the same time in one animal. Data on pest species would provide useful information for the formulation of particulate insecticides for use in management programs. (Wood-PTT)
W88-05049

SIZE- AND AGE-SPECIFIC PATTERNS OF TRACE METAL CONCENTRATIONS IN FRESHWATER CLAMS FROM AN ACID-SENSITIVE AND A CIRCUMNEUTRAL LAKE,
University of Western Ontario, London. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W88-05051

STRUCTURAL AND FUNCTIONAL COMPOSITION OF THE COMMUNITY OF CHIRONOMIDAE (DIPTERA) IN A CANADIAN SHIELD STREAM,
Waterloo Univ. (Ontario). Dept. of Biology.
R. S. Rempel, and A. D. Harrison.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 10, p 2545-2554, October 1987. 2 fig, 6 tab, 23 ref.

Descriptors: *Water pollution effects, *Ecosystems, *Species composition, *Streams, *Species diversity, *Midges, *Aquatic insects, Aquatic life, Insects, Temperature effects, Canisbay Creek, Ontario, Insect emergence, Larvae, Larval growth, Chemical properties, Aquatic enviroment, Water temperature.

The chironomid community of Canisbay Creek, a Shield region stream flowing in Algonquin Park, Ontario, revealed substantial differences in species structure and emergence phenology to that previously described for the community of a spring-fed wooded stream in southern Ontario. These differences are attributed to the different chemical and thermal regimes in the two streams. Weekly samples were taken from anchored floating emergence traps. Of the 72 species found, 15 are undescribed. Most were either Orthocladiinae or Tanytarsini; no Diamesinae were recorded. Both univoltine and multivoltine species occurred and some of the latter became asynchronous during spring and summer. Absolute temperatures and daily thermal divergence played important parts in emergence cuing. The Chironomidae were shown to be active components in the ecosystem throughout the year, indicating that the season of larval growth, along with relative body size, should be considered in the functional classification of the species in this group. (Author's abstract)
W88-05052

ALGAL AND BACTERIAL ACTIVITIES IN ACIDIC (PH 3) STRIP MINE LAKES,
Purdue Univ., Lafayette, IN. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-05058

DIEL VERTICAL MOVEMENTS OF THE CYANOBACTERIUM OSCILLATORIA TEREBRIFORMIS IN A SULFIDE-RICH HOT SPRING MICROBIAL MAT,
Oregon Univ., Eugene. Dept. of Biology.
L. L. Richardson, and R. W. Castenholz.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 9, p 2142-2150, September 1987. 8 fig, 2 tab, 29 ref. National Science Foundation grant.

Descriptors: *Lakes, *Springs, *Cyanobacterium, *Hot springs, Hydrogen sulfide, Oscillatoria terebriformis, Thermophilic bacteria, Bacteria, Diurnal variation, Population dynamics, Vertical distribution, Sulfides, Anaerobic conditions, Photosynthesis, Oxygen.

Oscillatoria terebriformis, a thermophilic cyanobacterium, carries out a diel vertical movement pattern in Hunter's Hot Springs, Oregon. Throughout most daylight hours, populations of O. terebriformis covered the surface of microbial mats in the hot spring outflows below an upper temperature limit of 54 C. Upon darkness trichomes move downward by gliding motility into the substrate to a depth of 0.5 to 1.0 mm, where the population remained until dawn. At dawn the population returns to the top of the mats. Field studies with microelectrodes showed that the dense population of O. terebriformis moved each night across an oxygen-sulfide interface, entering a microenvironment which was anaerobic and reducing, a dramatic contrast to the daytime environment at the mat surface where oxygenic photosynthesis resulted in supersaturated oxygen. Laboratory experiments on motility with the use of sulfide gradients produced in agar revealed a negative response to sulfide at concentrations similar to those found in the natural mats. The motility response may help explain the presence of O. terebriformis below the mat surface at night. The movement back to the surface at dawn appears to be due to a combination of phototaxis, photokinesis, and the onset of oxygenic photosynthesis which consumes sulfide. (Author's abstract)
W88-05060

SIMULATION OF DYNAMICS OF DOUBLE-DIFFUSIVE SYSTEM,
Stanford Univ., CA. Dept. of Civil Engineering.
S. G. Schladow.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 1, p 1-20, January 1988.

10 fig, 1 tab, 37 ref.

Descriptors: *Lakes, *Solar energy, *Solar ponds, *Ponds, *Saline water, *Saline lakes, *Temperature, *Diffusion, Double-diffusive system, Model studies, Mathematical models, DYSOSM model, Solute transport, Estuaries, Wastewater disposal, Wind, Windbreaks.

The DYSOSM model was used to study the dynamics of a double-diffusive system, the solar pond, in which diffusion is dependent on both temperature and salinity gradients. This phenomenon is seen not only in solar ponds but in coastal areas receiving fresh river water, wastewater effluent, or industrial waste discharges. The model proved useful in the site selection and design of solar ponds sites. Wind was shown to cause severe erosion of the gradient zone, but it produces conditions conducive for double-diffusive instability, leading to higher fluxes of heat and salt. Windbreaks and floating nets are techniques useful in reducing this instability. (Cassar-PTT)
W88-05073

BACTERIOPLANKTON IN LAKE MICHIGAN: DYNAMICS, CONTROLS, AND SIGNIFICANCE TO CARBON FLUX,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, and G. A. Laird.
Limnology and Oceanography LIOCAH, Vol. 32, No. 5, p 1017-1033, September 1987. 6 fig, 3 tab, 56 ref.

Descriptors: *Bacteria, *Carbon flow, *Plankton, *Limnology, Lake Michigan, Isotope studies, Grazing, Aquatic productivity, Bacterial physiology, Bacterial analysis, Isotopic tracers, Epilimnion, Hypolimnion.

Lake Michigan bacterial production, based on (3H-methyl)thymidine (TdR) incorporation and empirically determined conversion factors, decreased with distance from shore (approx 2x over 30 km), was higher at night (1.4x-2.2x), and decreased with depth (approx 10 x over 100 m). TdR-based growth rates were consistent with independent antibiotic- and dilution-based estimates. Population size varied little and appeared controlled by balanced growth and grazing. Growth correlated with temperature only below 10 C. Cell size ranged from 0.015 to 0.072 cu um. Carbon content averaged 0.154 +/- 0.047 picog/cu microm. Net annual C production was 142 g C/sq m/yr. Summer averages were 28.9 (epilimnion), 10.4 (10-35m), 1.6 (hypolimnion) microgram C/liter/day, and 652 mg C/sq m/day for the water column. Flux to microconsumers averaged 8.4 microgram C/liter/day in the summer epilimnion. It is suggested that temporal and spatial disequilibrium of labile organic C supply and bacterial use is responsible for the apparent discrepancy during summer. (Author's abstract)
W88-05091

ELECTROPHORETIC MOBILITY OF NATURAL PARTICLES AND CULTURED ORGANISMS IN FRESHWATERS,
Georgia Univ., Athens. Dept. of Zoology.
J. Gerritsen, and S. W. Bradley.
Limnology and Oceanography LIOCAH, Vol. 32, No. 5, p 1049-1058, September 1987. 6 fig, 2 tab, 20 ref. NSF Grant BSR 84-15851.

Descriptors: *Electrophoresis, *Limnology, *Particulate matter, *Organic carbon, *Hydrogen ion concentration, Chlorella, Klebsiella, Microcystis, Habitats, Hardness, Filter feeding, Dissolved solids, Lakes, Streams, Homeostasis.

Electrophoretic mobility (EM) was measured on natural particles from 11 southeastern United States lakes and streams. The mobility decreased with increased conductivity, increased with dissolved organic carbon (DOC), and increased with pH. EM was further measured in each water sample with pH adjusted over the pH range 3-10. In general, mobility increased with pH, but particles in hard waters were only slightly affected, whereas particles in soft waters with high DOC showed a sharper rise in EM due to increased pH. The experiments were repeated with Microcystis aeruginosa, Chlorella vulgaris, and Klebsiella sp. in filtered water from several of the sites. Cultured cells showed greater homeostasis of EM in the pH gradient than the natural particles, but cells in soft water with high DOC had greater mobility than those in hard water. The three species differed in their mobility: Microcystis consistently had the highest EM and Chlorella the lowest; Chlorella was neutral in hard waters. The results indicate that individual habitats and particle species may represent different challenges to filter feeders, based on particle surface chemistry. (Author's abstract)
W88-05092

SEASONAL AND LONGITUDINAL VARIATIONS IN APPARENT DEPOSITION RATES WITHIN AN ARKANSAS RESERVOIR,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5C.
W88-05097

BIG SODA LAKE (NEVADA): 1. PELAGIC BACTERIAL HETEROTROPHY AND BIOMASS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. P. Zehr, R. W. Harvey, R. S. Oremland, J. E. Cloern, and L. H. George.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 781-793, July 1987. 8 fig, 1 tab, 38 ref.

Descriptors: *Meromictic lakes, *Heterotrophic bacteria, *Seasonal distribution, *Limnology, *Nevada, Mixolimnion, Anaerobic conditions, Monimolimnion, Biomass, Chemocline, Oxycline, Isotope studies, Big Soda Lake, Photosynthesis, Aquatic productivity.

Bacterial activities and abundance were measured seasonally in the water column of meromictic Big Soda Lake, which is divided into three chemically distinct zones: aerobic mixolimnion, anaerobic mixolimnion, and anaerobic monimolimnion. Bacterial abundance ranged from 5 to 52 million cells/ml, with highest biomass at the interfaces between these zones: 2-4 mg C/l in the photosynthetic bacterial layer (oxycline) and 0.3-1.0 mg C/l in the chemocline. Bacterial cell size and morphology also varied with depth. Heterotrophic activity was measured by tritiated thymidine incorporation and (14C)glutamate uptake. Highest uptake rates were at, or just below, the photosynthetic bacterial layer and were attributable to small (less than 1 micrometers) heterotrophs rather than large photosynthetic bacteria. These high rates of heterotrophic uptake apparently were linked to fermentation. Heterotrophic activity in the highly reduced monimolimnion generally was much lower than elsewhere in the water column. Although the monimolimnion contained most of the bacterial abundance and biomass (approx 60%), most of the cells were inactive. (See W88-05099 thru W88-05101) (Author's abstract)
W88-05098

BIG SODA LAKE (NEVADA): 2. PELAGIC SULFATE REDUCTION,
Geological Survey, Lakewood, CO.
R. L. Smith, and R. S. Oremland.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 794-803, July 1987. 3 fig, 4 tab, 35 ref.

Descriptors: *Meromictic lakes, *Sulfates, *Sulfides, *Limiting Nutrients, *Bacteria, *Limnology, Epilimnion, Anaerobic conditions, Monimolimnion, Seasonal distribution, Isotope studies, Big Soda Lake, Nevada, Temperature.

The epilimnion of hypersaline, alkaline, meromictic Big Soda Lake contains an average 58 mmol sulfate/l and 0.4 umol dissolved iron/l. The monimolimnion, which is permanently anoxic, has a sulfide concentration ranging seasonally from 4-7 mmol/l. Depth profiles of sulfate reduction in the monimolimnion, assayed with 35S tracer technique and in situ incubations, demonstrated that sulfate reduction occurs within the water column of this extreme environment. The average rate of reduction in the monimolimnion was 3 micromol sulfate/l/day in May compared to 0.9 in October. Sulfate reduction also occurred in the anoxic zone of the mixolimnion, though at significantly lower rates (0.025-0.090 micromol/l/day at 25 m). Additions of FeS (1.0 mmol/l) doubled the endogenous rate of sulfate reduction in the monimolimnion, whereas MnS and kaolinite had no effect. These results suggest that Big Soda Lake is iron limited and controlled by seasonal variables other than temperature. (See W88-05098, W88-05100 thru W88-05101) (Author's abstract)
W88-05099

BIG SODA LAKE (NEVADA): 3. PELAGIC METHANOGENESIS AND ANAEROBIC METHANE OXIDATION,
Institute of Water, Soil, and Environmental Technology, Aalborg (Denmark).
N. Iversen, R. S. Oremland, and M. J. Klug.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 804-814, July 1987. 5 fig, 2 tab, 43 ref. NSF Grant DEB 81-09994, Danish Nat. Sci. Res. Counc. Grant 11-3141.

Descriptors: *Limnology, *Meromictic lakes, *Methane bacteria, *Methane, Mixolimnion, Anaerobic conditions, Monimolimnion, Isotope studies, Big Soda Lake, Nevada, Aquatic productivity.

In situ rates of methanogenesis and methane oxidation were measured in meromictic Big Soda Lake. Methane production was measured by the accumulation of methane in the headspaces of anaerobically sealed water samples; radiotracer was used to follow methane oxidation. Nearly all the methane oxidation occurred in the anoxic zones of the lake. Rates of anaerobic oxidation exceeded production at all depths studied in both the mixolimnion (2-6 vs 0.1-1 nmol/l/day) and monimolimnion (49-85 vs 1.6-12 nmol/l/day) of the lake. Thus, net consumption of methane equivalent to 1.36 mmol/sq m/day occurred in the anoxic water column. Anaerobic methane oxidation had a first-order rate constant 8.1 + or - 0.5 x 10 to the minus 4th power/day, and activity was eliminated by filter sterilization. However, in situ methane oxidation was of insufficient magnitude to cause a noticeable decrease of ambient dissolved methane levels over an incubation period of 97 hr. (See W88-05098 thru W88-05099, W88-05101) (Author's abstract)
W88-05100

BIG SODA LAKE (NEVADA): 4. VERTICAL FLUXES OF PARTICULATE MATTER. SEASONALITY AND VARIATIONS ACROSS THE CHEMOCLINE,
Geological Survey, Menlo Park, CA.
J. E. Cloern, B. E. Cole, and S. M. Wienke.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 815-824, July 1987. 4 fig, 2 tab, 27 ref.

Descriptors: *Meromictic lakes, *Particulate matter, *Seasonal distribution, *Organic carbon, *Chemocline, *Limnololy, Mixolimnion, Pycnocline, Bacteria, Seston, Chlorophyll a, Big Soda Lake, Nevada, Photosynthesis, Aquatic productivity, Density.

Vertical fluxes of particulate organic matter were measured with sediment traps above and below the chemocline of Big Soda Lake to define the seasonality of sinking losses from the mixolimnion and determine the effectiveness of the chemocline (pycnocline) as a barrier to the sinking of biogenic particles. Seasonality of sedimentation rates reflected seasonal changes in the community of autotrophs. During summer-autumn, when production is dominated by autotrophic bacteria, vertical fluxes were small: approx 100 mg C/sq m/day and approx 0.5 mg Chl a/sq m/day. Following the winter diatom bloom, vertical fluxes increased markedly to approx 570 mg C/sq m/day and 23 mg Chl a/sq m/day. More than 80% of the seston and about 65% of the particulate carbon sinking to the chemocline passed through it, showing that this very sharp density discontinuity does not effectively retard the sinking of particulate matter.

Sinking losses of particulate matter were generally small (approx 10%) relative to previous measures of primary productivity, indicating that the mixolimnion is a zone of efficient C cycling. Exceptions occurred following the winter bloom, when sinking losses were about 40% of productivity. (See W88-05098 thru W88-05100) (Author's abstract)
W88-05101

ALKALINITY DYNAMICS IN AN UNACIDIFIED ALPINE LAKE, SIERRA NEVADA, CALIFORNIA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. L. Stoddard.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 825-839, July 1987. 9 fig, 5 tab, 44 ref. University of California Water Resources Center Grant UCAL-WRC-W-619.

Descriptors: *Acid rain, *Limnology, *Hydrogen ion concentration, *Alkalinity, *Seasonal distribution, Snowmelt, Runoff, Acidification, Hydraulic residence time, Mountain lakes, Sierra Nevada, Weathering, Mass balance equations, Groundwater runoff.

Gem Lake, a small, high-elevation lake, undergoes an annual cycle of low alkalinity (between 30 and 40 microeq/l) during the ice-free season and high alkalinity (greater than 240 microeq/l) in fall and winter. Both pH and alkalinity decrease drastically during spring snowmelt, but chemistry of the snow, snowmelt, and runoff indicate that the declines in alkalinity are due to dilution rather than acidification. The hydraulic residence time in the lake increases from about 135 days in winter to less than 7 days during snowmelt; high alkalinity water is flushed from the lake and replaced by water with an ionic composition very near that of the snowmelt runoff. Increases in alkalinity in fall and winter can be accounted for by the rates of weathering in the watershed. A mass balance approach was used to reconstruct the weathering reactions. It suggests that the lake receives both surface runoff, with weathering products of the hydrolysis of granodiorite minerals to kaolinite, and deep water from subterranean circulation, with the products of granodiorite weathering to both kaolinite and smectite. (Author's abstract)
W88-05102

FIELD EXPERIMENT ON THE INFLUENCES OF SUSPENDED CLAY AND P ON THE PLANKTON OF A SMALL LAKE,
Shaw Univ., Raleigh, NC. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-05103

EXPERIMENTAL STUDIES OF PHYSICAL FACTORS AFFECTING SESTON TRANSPORT IN STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2E.
W88-05104

FLUOROCHROME-STAINING TECHNIQUE FOR COUNTING BACTERIA IN SALINE, ORGANICALLY ENRICHED, ALKALINE LAKES,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W88-05107

2I. Water In Plants

EFFECTS OF LIGHT AND INTERTIDAL POSITION ON SEEDLING SURVIVAL AND GROWTH IN TROPICAL TIDAL FORESTS,
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2L.
W88-04509

CROP-WATER PRODUCTION FUNCTIONS FOR SWEET CORN AND COTTON IRRIGATED WITH SALINE WATERS,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 3C.
W88-04639

MASS LOSS AND NUTRIENT CHANGES IN DECOMPOSING UPLAND OAK AND MESIC MIXED-HARDWOOD LEAF LITTER,
Tennessee Valley Authority, Oak Ridge.
J. M. Kelly, and J. J. Beauchamp.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1616-1622, November-December 1987. 3 fig, 3 tab, 33 ref.

Descriptors: *Forest watersheds, *Nutrient cycling, *Decomposition, *Litter, Organic matter, Nitrogen, Potassium, Calcium, Sulfur, Magnesium, Mathematical models, Model studies.

Nylon net litterbags (30 by 30 cm) containing approximately 10 gm of upland oak leaf litter were collected at 30-day intervals over a 1110-d period from two upland oak (Quercus sp.)-mixed hardwood stands on the Cumberland Plateau of Tennessee. Statistically significant differences ($P \leq 0.01$) in losses of mass, N, K, Ca, and S were found between sites, whereas P and Mg losses did not differ. Statistical comparisons indicated significant differences in mass, N, P, K, Ca, Mg and S loss between sites. Constant rate projections of the time required for the upland oak litter weight to reach 10% of the original bag content based on 365, 730, and 1095 d of data were 960, 1530, and 1770 d, respectively, at the Camp Branch Watershed and 870, 1230, and 1410 d at the Cross Creek Watershed. Estimates of decomposition times derived from constant rate projections for both cover types were considerably less than observed values. In an attempt to obtain more realistic projections of weight and nutrient loss, several mathematical models commonly used to examine decomposition data were evaluated. The results of this analysis, in addition to suggesting that a longer time is required for decomposition than is normally projected, also suggest that a single model may not be appropriate to describe all response variables. Data presented here along with the modeling work also reiterate the fact that a decay rate derived from a single species or group of species must be applied with caution over larger landscape units because of the potential differences both within and among sites. (Lantz-PTT)
W88-04650

RESPONSE OF CASSAVA TO WATER STRESS,
Centro Internacional de Agricultura Tropical, Cali (Colombia).
M.A. El-Sharkawy, and J.H. Cock.
Plant and Soil PLSOA2, Vol. 100, No. 1-3, p 345-360, 1987. 10 fig, 3 tab, 17 ref.

Descriptors: *Crop yield, *Water stress, *Roots, *Cassava, *Leaf area index, Plant breeding, Drought resistance, Lysimeters, Moisture deficiency.

Cassava (Manihot esculenta Crantz), a staple food for a large sector of thehuman population in the tropics. can survive for several months without rain. There is a wide variation within the cassava germplasm for tolerance to prolonged drought and the possibility to breed and select for stable and relatively high yields under favorable and adverse conditions does exist. Research involving several cassava clones, using a drainage field lysimeter 30 m x 15 m x 2.3 m deep showed that high root yield under mid-term stress is not incompatible with high yields under nonstress conditions. Plant types with high yield potential under both conditions (e.g. the hybrid CM 507-37) are characterized by having slightly higher than optimum leaf area index under nonstress conditions, higher leaf area ratio and more intensive and extensive fine root system, perhaps requiring diversion of more dry matter into an extensive fibrous root system. (Author's abstract)
W88-04655

ENERGY RELATIONS IN CLADOPHORA GLOMERATA FROM LAKE ERIE,
State Univ. of New York Coll. at Fredonia. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-05030

DYNAMICS OF LAKE MICHIGAN PHYTOPLANKTON: THE DEEP CHLOROPHYLL LAYER,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W88-05031

FORAGING CHARACTERISTICS OF CANADA GEESE ON THE NISUTLIN RIVER DELTA, YUKON,
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W88-05048

2J. Erosion and Sedimentation

MEASUREMENT OF WATERDROP IMPACT PRESSURES ON SOIL SURFACES,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. A. Nearing, J. M. Bradford, and R. D. Holtz.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1302-1306, September-October 1987. 3 fig, 1 tab, 19 ref.

Descriptors: *Waterdrop impact, *Erosion, *Soil surfaces, *Soil erosion, Soil stability, Piezometry, Loam, Rain.

Limited data on pressures induced by waterdrop impact on soil surfaces restricts the understanding of the mechanism of soil detachment due to raindrop impact. Impact pressures on rigid surfaces are known but their application to soil surfaces is questionable. This study was undertaken to measure vertical pressures of waterdrop impact on soil surfaces. A 1-mm diameter piezoelectric transducer was developed and measurements of impact pressures as a function of radial distance from drop center were made. Dickinson loam (coarse-loamy, mixed, mesic Typic Hapludoll) and Ida silt loam (Fine-silty, mixed (calcareous) mesic Typic Udorthent) with bulk densities of 1.0 and 1.2 mg/cu m and with matric potentials of -0.5 and -2.5 kPa were used. The waterdrop had a diameter of 5.6 mm and a fall height of 14 m. Average peak impact pressures were greatest at a distance of 1.8 to 2.3 mm from center of impact and of the order of 190 to 290 kPa. These stress levels are almost two orders of magnitude less than those for impact on a rigid surface. Much of the difference between soil and rigid cases was due to nonrigid, nonhomogeneous nature of the soil material. The remainder of the difference in stress levels was thought to be due to the effect of soil granularity or to the presence of surface and shear waves generated by impact. (Author's abstract)
W88-04501

INFILTRATION AND SOIL LOSS OF THREE GYPSUM-AMENDED ULTISOLS UNDER SIMULATED RAINFALL,
Georgia Univ., Athens. Dept. of Agronomy.
W. P. Miller.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1314-1320, September-October 1987.

Descriptors: *Soil amendments, *Soil management, *Infiltration, *Soil erosion, *Gypsum, *Ultisols, *Simulated rainfall, Phosphogypsum, Runoff, Soil properties.

By-product phosphogypsum (PG) was applied to the surface of topsoil samples from three sandy Georgia Ultisols at a rate of 5 mg/hr in 0.3 sq m runoff trays to test the efficacy of this amendment in enhancing infiltration of these soils. Simulated rainfall was applied at 50 mm/hr for 2.5 hr in an initial 1-hr (dry) event and three subsequent 0.5 hr (wet) events applied 24 hr later. In the absence of

gypsum, infiltration rate stabilized at 10 mm/hr for the Cecil soil (Typic Hapludults), 5 mm/hr for the Wedowee (Typic Hapludults), and 1 mm/hr for the Worsham (Typic Ochraqualts), with surface crusting and sand sorting apparent on all the soils. Surface-applied PG roughly doubled the final infiltration rate of the Cecil and Wedowee soils, and increased infiltration of the Worsham to a lesser degree. Cumulative and average infiltration was significantly higher on all of the PG-amended soils. Soil loss on the Worsham and Wedowee soils was decreased by 50% with the use of PG, and was reduced by 30% on the Cecil. Sediment concentrations were somewhat lower during the wet events with PG treatment for the Worsham and Wedowee soils, showing that less detached soil was available for transport. Although sediment particle sizes for control soils were 15 to 30% clay and 60 to 75% silt PG-amended soils showed no clay-sized sediment in the runoff, but higher silt contents. Electrical conductivity measurements of the runoff suggest the very low electrolyte concentrations in the untreated soils promote dispersion, resulting in pore blockage and high sediment transportability, whereas PG maintained a high enough electrolyte level (0.5-1.3 dS/m) to keep soil clays flocculated, thereby reducing crusting and sediment availability. (Author's abstract)
W88-04503

SEDIMENT-YIELD HISTORY OF A SMALL BASIN IN SOUTHERN UTAH, 1937-1976: IMPLICATIONS FOR LAND MANAGEMENT AND GEOMORPHOLOGY,
Geological Survey, Flagstaff, AZ.
R. Hereford.
Geology GLGYB, Vol. 15, No. 10, p 954-957, October 1987. 5 fig, 20 ref.

Descriptors: *Sediment yield, *History, *Land management, Sedimentation, Rainfall intensity, Reservoirs, Sediment control.

Alluvium deposited in a reservoir from 1937 to 1976 records the sediment-yield history of a small (2.8 sq km), high-relief basin in semiarid southern Utah. Stratification in the alluvium shows that sediment was deposited in the reservoir only 21 times in 38 yr, a runoff recurrence interval of 1.8 yr. Thus, on average, the particular combination of rainfall intensity, duration, and antecedent moisture conditions producing runoff did not recur often. On the basis of the volume of beds in the reservoir fill, sediment yield of individual runoff events averaged 2500 cu m/sq km (5.3 a-ft/sq mi) with slightly less than one order of magnitude variation. This low variation is not expected of small basins and probably resulted from limited hillslope sediment supply, suggesting that transport processes were more rapid than weathering processes. Sediment yield, therefore, was evidently controlled by the availability of freshly weathered material. (Author's abstract)
W88-04504

RAINFALL, GROUND-WATER FLOW, AND SEASONAL MOVEMENT AT MINOR CREEK LANDSLIDE, NORTHWESTERN CALIFORNIA: PHYSICAL INTERPRETATION OF EMPIRICAL RELATIONS,
Cascades Volcano Observatory, Vancouver, WA.
For primary bibliographic entry see Field 2A.
W88-04530

SOIL LOSS AND RUNOFF FROM NATURAL VELD IN THE CENTRAL ORANGE FREE STATE (SEDIMENTVERLIES EN OPPERVLAKFLOOP VANAF NATUURLIKE VELD IN DIE SENTRALE ORANJE-VRYSTAAT),
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Soil Science.
H. A. Snyman, and W. L. J. Van Rensburg.
Water SA, Vol. 13, No. 4, p 245-250, August 1986. 6 fig, 23 ref.

Descriptors: *Soil loss, *Soil erosion, *Runoff, *Rainfall-runoff relationships, Erosion, Vegetation, Grasses, Succession, Simulated rainfall.

A rotating-boom rainfall simulation is being used to measure soil losses and runoff from natural veld in different successional stages at a 1.8% slope on a Valsrivier soil form. Plant cover and composition had a significant influence on soil loss and runoff. Soil loss from the pioneer grass cover (0.7% basal cover) was as much as 3.9 t/ha. No runoff was recorded from the climax grass cover (7.1% basal cover). (Author's abstract)
W88-04570

EFFECTS OF HYDROLOGICAL FACTORS ON RIVER SUSPENDED SOLIDS CONTAMINATION FROM A COLLIERY IN SOUTH WALES,
University Coll. of Swansea (Wales). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W88-04572

QUALITY OF SUSPENDED AND BOTTOM SEDIMENTS OF THE ST. LAWRENCE SYSTEM (CANADA) (QUALITE DES SEDIMENTS EN SUSPENSION ET DE FOND DU SYSTEME SAINT-LAURENT (CANADA)),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W88-04591

BASIN PROPERTIES AND POSTGLACIAL EROSION RATES OF MINOR MORAINES IN IOWA,
Ohio State Univ., Columbus. Dept. of Agronomy.
C. L. Burras, and W. H. Scholtes.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1541-1547, November-December 1987. 5 fig, 4 tab, 18 ref.

Descriptors: *Erosion rates, *Moraines, *Iowa, Soil properties, Stratigraphy, Sedimentation, Particle size, Erosion.

Two minor moraine basins in Story County, Iowa, were examined to determine the extent and effect of postglacial erosion on the present landscape and stratigraphy. Minor moraines are subtle repeating ridge and valley landforms with relief of approximately 2 m. The stratigraphy was examined in this study using grid and transect borings. A mantle of locally derived postglacial sediment blanketed the Late Wisconsinan till in both basins. In places, a strata of coarse diamicton separated the till and sediment. The postglacial sediment was identified primarily on particle size distribution and bulk density. After determining the extent and thickness of sediment in each basin, the sediment volume and mass were calculated. Previously, the Late Wisconsinan till in central Iowa was dated as being deposited 14,000 radio carbon years before present. This age was used to calculate a gross annual rate of postglacial erosion. The basin with modern relief of 2.7 m had a 0.9 mg/ha/yr erosion rate and the basin with modern relief of 1 m had a 0.7 mg/ha/yr erosion rate. (Author's abstract)
W88-04638

INTERRILL SOIL EROSION PROCESSES: I. EFFECT OF SURFACE SEALING ON INFILTRATION, RUNOFF, AND SOIL SPLASH DETACHMENT,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
J. M. Bradford, J. E. Ferris, and P. A. Remley.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1566-1571, November-December 1987. 7 fig, 3 tab, 22 ref.

Descriptors: *Soil erosion, *Soil sealants, *Infiltration, *Runoff, *Interrill erosion, Rainfall-runoff relationships, Rainfall impact, Soil properties.

Soil erosion from interrill areas is a function primarily of soil detachment by raindrop impact and transport capacity of thin sheet flow. Soil detachment normally is the rate-determining process and is controlled, to a large extent, by surface sealing and crusting. The purpose of this study was to measure the effect of surface sealing on infiltration, runoff, and soil loss for 20 soils ranging in texture from sand to clay. Wash and splash erosion were measured for near-saturated soils in 0.14-sq m Al pans exposed to laboratory simulated rainfall with an intensity of about 63 mm/h for 1 h. For most soils, wash and splash amounts decreased with time due to surface sealing with the decrease in wash being much less than the decrease in splash. Comparing the 20 soils, surface sealing caused a reduction in infiltration rate ranging from 1.2 to 36.0 mm/h and an increase in shear strength ranging from 2.6 to 42.3 kPa, resulting in a decrease in total soil loss ranging from 13.3 to 56.8 g/5 min. Total soil loss, splash, and wash were highly intercorrelated ($p < 0.001$). (See also W88-04651) (Author's abstract)
W88-04641

INTERRILL SOIL EROSION PROCESSES: II. RELATIONSHIP OF SPLASH DETACHMENT TO SOIL PROPERTIES,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
J. M. Bradford, J. E. Ferris, and P. A. Remley.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1571-1575, November-December 1987. 5 tab, 28 ref.

Descriptors: *Soil erosion, *Soil sealants, *Infiltration, *Runoff, *Soil splash, *Interrill erosion, Soil mechanics, Soil stability, Surface sealing, Rainfall-runoff relationships, Rainfall impact, Soil properties, Mathematical models, Simulated rainfall.

Although soil erodibility is often estimated using predictive equations based on easily measurable soil parameters, most predictive equations are valid for a limited group of soils and do not account for temporal changes in surface conditions. The present study sought to identify those soil properties that affect interrill splash and to develop an interrill detachment model based on both static and dynamic soil properties. Twenty soils ranging in texture from sand to clay were exposed to laboratory simulated rainfall with an intensity if about 63 mm/h. The development of a surface seal decreased infiltration rate, splash, wash erosion, and increased soil strength, as measured with a fall-cone device. The best predictor of soil splash for the surface seasled condition was a combined kinetic energy/fall-cone strength (KE/tau) and total silt content term, and of total soil loss, a KE/tau and coarse silt content term. Comparing results from this study with previously reported studies, it was concluded that for improvement of laboratory-based indices, greater attention must be given to dynamic soil properties such as the soil's resisting force to raindrop impact and surface flow. (See also W88-04650) (Author's abstract)
W88-04642

PARTICLE SIZE OF INTERRILL-ERODED SEDIMENTS FROM HIGHLY WEATHERED SOILS,
Georgia Univ., Athens. Dept. of Agronomy.
W. P. Miller, and M. K. Baharuddin.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1610-1615, November-December 1987. 4 fig, 3 tab, 23 ref.

Descriptors: *Particle size, *Sediment yield, *Weathering, *Soil erosion, Runoff rates, Simulated rainfall, Laboratory experiments, Silt, Clays, Mathematical analysis, Sediment transport, Sediments.

Fifteen highly weathered Alfisols and Ultisols from Georgia were used in runoff/erosion pan studies to delineate sediment characteristics of interrill-eroding soils and their relationship to soil particle size. Simulated rainfall was applied to the pans at 11.2 cm/hr, and runoff and sediment parameters were measured at 5-min intervals for 25 min. Runoff rates and sediment concentrations varied consistently over time for the soils used, with concentrations increasing until peaking at 10 to 15 min, then decreasing as crust formation caused surface consolidation and decreasing as crust formation caused surface consolidation and decreased detachability, despite continued high runoff rates for most of the soils. Sediment particle size became fine after the initial sampling period, and was dominated by silt-sized particles, with

lesser amounts of primary clay and sand. Silt-sized sediment contents averaged over the event accounted from 50 to 75% of the total sediment, and were related to a measure of water-dispersible soil silt. Primary sediment clay ranged from 10 to 30% of the sediment, and correlated with both water-dispersible and total soil clay. The higher correlation with total clay may reflect the inadequacy of the laboratory dispersion test to accurately simulate the highly dispersive environment at the soil surface, both in terms of the quantity of input energy due to raindrop impact, and in the fact that dispersed particles are constantly being removed from the soil surface under rainfall conditions. A quadratic equation using soil clay described sediment clay content, showing greater relative enrichment of primary clay in sediments from sandy vs. clayey soils. The high proportion of easily transportable sediment generated by interrill erosion on these soils poses a serious environmental problem in areas of active soil erosion. (Author's abstract) W88-04649

MICROBIAL REDUCTION OF STRUCTURAL IRON(III) IN SMECTITES,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
J. W. Stucki, P. Komadel, and H. T. Wilkinson.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1663-1665, November-December 1987. 2 fig, 1 tab, 20 ref. Army Research Office Contract No. DAAG29-84-k-0167.

Descriptors: *Microbiological degradation, *Iron, *Smectites, *Soil environment, *Weathering, *Soil bacteria, *Reduction, Bacteria, Microorganisms, Aerobic environment, Clays, Microbiological studies.

Octahedral Fe(III) in the crystal structures of three different smectites was reduced to Fe(II) by actively growing microorganisms indigenous to the clay. The smectites were SWa-1 ferruginous smectite from Grant County, Washington; API33a, Garfield Nontronite; and API25, Upton montmorillonite. Bacterial growth was supported by incubating clay suspensions at room temperature in a nutrient broth solution consisting of peptone and beef extract. Some samples were first sterilized (by autoclaving), then seeded with bacteria that had been isolated previously from the SWa-1 sample. The effect of O2 on microbial reduction of Fe(III) was also tested. Results revealed that, in all three clays, about 0.30 mmol Fe(III)/g clay was reduced to Fe(II) by bacteria in a 28-day period. The specific organism responsible for Fe reduction has yet to be classified, but it was more efficient in samples that had not been purged of O2, and it appears to be indigenous to the SWa-1 clay. (Author's abstract) W88-04654

METHODOLOGY OF MODELING SEDIMENT TRANSPORT IN WATER RESOURCES SYSTEMS,
Mississippi Univ., University. Center for Computational Hydroscience and Engineering.
S. S. Y. Wang.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 41-53, 17 fig, 15 ref. Mississippi Water Resources Research Inst. Grant No. G1026-05.

Descriptors: *Sediment transport, *Model studies, *Hydraulic models, *Computer models, Simulation analysis, Mathematical studies, Hydraulic properties, Hydrodynamics.

The capabilities and limitations of several hybrid simulation models developed and tested recently by the Center for Computational Hydroscience and Engineering at the University of Mississippi were evaluated for sediment transport. Numerical methodologies and reliable empirical functions were applied to construct these numerical-empirical models. Not only are the hydrodynamic and sediment transport phenomena predicted by these models reasonable, but their validity and accuracy have also been verified. It has become clear that cost-effective research methodology in hydraulic and sedimentation investigations of water resources systems should be a well-coordinated combination of physical or hydraulic modeling and computational simulation, and that the computer simulation of a complete water resources system should be carried out by a mixed-dimensional (d) model specially formulated by the most appropriate 1-d, 2-d, quasi-3-d, and fully 3-d modules to represent different parts of the specific system, so that it can be modeled accurately and efficiently. (See also W88-04655) (Lantz-PTT) W88-04675

STREAM CHANNEL EROSION CONTRIBUTION TO SEDIMENT YIELDS IN COMPLEX WATERSHEDS,
Agricultural Research Service, Oxford, MS.
A. J. Bowie.
IN: Proceedings of the Seventeenth Misaissippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 55-61, 6 fig, 7 tab, 8 ref.

Descriptors: *Channel erosion, *Sediment yield, *Mississippi, Channel flow, Streams, Erosion rates, Sediment transport, Erosion, Dredging.

Surveys were made over a 19 year period on approximately 57 miles of permanent well-defined channels in a north Mississippi watershed. These surveys were made in order to determine the extent of channel contribution to sediment yield. Surveys indicated erosion rates for natural undredged channels ranged from 12 to 55% of the total watershed sediment yield. With the exception of one subwatershed, channel bed erosion was twice as much as bank erosion. The studies revealed that soil conditions, land use changes, and channel dredging have a profound effect on channel erosion. Because deposition usually occurs in most of the downstream drainageways, they must be dredged periodically, and as a result, a high rate of erosion may occur. Channel erosion rates for a recently dredged channel were exceedingly high. A change in the flow regime resulted in greatly increased velocities, which caused excessive erosive action along unprotected channel banks. During high stages and prolonged periods of storm flow, the moisture content of the channel banks increased to the point of saturation. Soil resistance to shear was overcome by its own weight causing large sections of the bank to slide into the stream. Channel erosion rates as high as 430 tons/inch of runoff/yr were computed for the dredged channel. This is equivalent to 13,000 tons/channel mile/yr. Combined channel erosion for the 19 year period of record averaged 29% of the total measured sediment discharge for the 177 sq mi watershed. (See also W88-04655) (Lantz-PTT) W88-04676

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 1: A REVIEW OF ESTUARY HYDRAULICS AND TRANSPORT AS APPLIED TO RIVERS TRIBUTARY TO LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04701

ANALYSIS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 2: LITTORAL DRIFT PROCESSES AT ESTUARY MOUTHS - A CASE STUDY AT OLD WOMAN CREEK IN LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04702

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 3: A LATERALLY AVERAGED MODEL OF MOMENTUM AND ENERGY TRANSPORT WITH APPLICATION TO SEICHE HYDRAULICS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04703

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 4: THE EFFECT OF LAKE ERIE/SANDUSKY BAY SEICHE OSCILLATIONS ON THE FORMATION OF SANDUSKY BAY,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04704

DEVELOPMENT OF A SEDIMENT TRANSPORT MODEL FOR FIELD APPLICATIONS,
Mississippi Univ., University. Center for Computational Hydroscience and Engineering.
S. S. Y. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116793/AS. Price codes: A03 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Interim Report G1234-06, July 1987. 31 p, 20 fig, 39 ref. Contract No. 14-08-001-G1234. Project No. USGS G1234-06.

Descriptors: *Mathematical models, *Model studies, *Simulation analysis, *Sediment transport model, Soils, Sedimentation, Cost analysis, Mixed-dimensional models, Model testing.

A numerical-empirical computational model is needed to investigate the sedimentation process occurring in water resources systems. In a previous research project, the basic mathematical modeling methodology for simulating the hydrodynamic as well as sedimentation phenomena has been advanced significantly. A series of 1-d, 2-d, and 3-d numerical-empirical models has been developed. In this new project, all of these models are being improved and refined, so that models have been verified by the laboratory hydraulic models. The capabilities and limitations of these improved computational models are described. In order to achieve the optimum cost-effectiveness, a mixed-dimensional model is to be assembled, which consists of all the models having been developed. This mixed-dimensional model is to be utilized in the investigation of a larger water resources system, in which the 1-d model may be adopted in a subregion where the variations of field properties in the lateral and vertical directions are not as significant as those in the longitudinal direction, the 2-d models can be utilized in subregions where shallow water flow approximation can be applied, and the 3-d models are applied in the close vicinities of hydraulic structures, where the flow and sediment transport phenomena are highly three-dimensional. This most cost-effective model is to be completed and applied to study the sedimentation effect on water resource. (Wang-U. MS.) W88-04751

OGALLALA DEPOSITIONAL MYSTERY,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
C. C. Reeves Jr.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 129-156, 15 fig, 42 ref.

Descriptors: *Alluvial deposits, *Geologic history, *Ogallala Aquifer, *Alluvial fans, *Alluvial aquifers, *Deposition, Aquifer characteristics, Sedimentary structures, Aquifers, Geology, Groundwater reservoirs, Petrology.

Previous investigators, using little, selective, or even no substantive evidence, have suggested that the Ogallala section of West Texas represents everything from a gigantic alluvial fan to a series of individual, overlapping fans of different ages (but collectively of Ogallala age). Correlation of all available evidence, which includes clay mineralogy, invertebrate (mollusks) remains, vertebrate and fossil floral zones, and petrology of Ogallala gravels, indicates that Ogallala-aged sediment was deposited contemporaneously from Nebraska south to at least the Lubbock, Texas, area. This evidence, when combined with water well logs and outcrop data in New Mexico, shows that four major stream systems persisted throughout Ogallala time in the eastern New Mexico - West Texas area. Thus, the

Ogallala section of West Texas is not a series of overlapping fan lobes of different ages, but a series of coalescent fan lobes produced by lateral merging. Even so, substantial regional evidence shows that the Ogallala of the Southern High Plains was not deposited entirely by fluvial processes. Because of topographic highs in the central part of the Southern High Plains, and regional lows to the north and southwest produced by dissolution of Permian salt, initial (Valentine) deposition probably occurred north of the Canadian River and southwest of the Mescalero Ridge in New Mexico. However, the absence of westward-facing escarpments allowed lowermost Ogallala sediments to also override more eastern mesa-like areas, probably before bounding escarpments were buried by adjacent alluvial debris. (See also W88-04894) (Author's abstract)
W88-04903

DEVELOPMENT AND ESCARPMENT RETREAT OF THE SOUTHERN HIGH PLAINS,
Geological Survey, Reston, VA.
W. R. Osterkamp, and W. W. Wood.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 177-193, 3 fig, 48 ref.

Descriptors: *Geomorphology, *Ogallala Aquifer, *Geologic formations, *Geologic history, Aquifer characteristics, Alluvial aquifers, Petrology, Playas, Geohydrology, Geomorphology, Geology, Erosion, Runoff, Alluvial deposits, High Plains, Pliocene, Pleistocene, Holocene.

Available geologic and hydrologic information suggests that types and rates of processes eroding the Ogallala Formation of the Southern High Plains have been variable through time. Following the cutoff of water and sediment from the west by the Pecos River starting in the early Pliocene Epoch, the surface of the present Southern High Plains became quite stable, had little fluvial erosion, and developed a massive caliche caprock. However, precipitation was probably too great east of the present escarpment to favor caprock formation significantly, and therefore resistant outliers of the Ogallala Formation are lacking. Fluvial erosion during the Pliocene and Pleistocene Epochs was probably active east of the present plateau, but Holocene erosion and perennial streamflow on the present Southern High Plains have been very limited. Holocene scarp retreat has occurred principally by seepage erosion and related processes of mass wasting. (See also W88-04894) (Author's abstract)
W88-04905

COMMENTS ON THE GEOLOGIC HISTORY OF THE OGALLALA FORMATION IN THE SOUTHERN PANHANDLE OF NEBRASKA,
Nebraska Geological Survey, Lincoln.
R. F. Diffendal Jr.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 194-216, 8 fig, 1 tab, 54 ref.

Descriptors: *Geologic history, *Ogallala Aquifer, *Geologic formations, *Nebraska, *Aquifer characteristics, Geohydrology, Geology, Petrology, Erosion, Deposition, Alluvial plains, Alluvial deposits, Alluvial fans, Alluvial aquifers, Wyoming, Colorado, Volcanic ash.

The southern Panhandle of Nebraska and the adjoining parts of southeastern Wyoming and northeastern Colorado are unusual places to examine the geologic history of the Ogallala Formation because they are much closer to the source areas of much of the sediment which makes up the unit than are other sites along the Ogallala coutcrop belt. This study in Nebraska combined with results of earlier work there, in southeastern Wyoming, and northeastern Colorado, outlines the complex cut and fill history of the Ogallala close to Rocky Mountain source areas. Parts of the Ogallala consist of fills of sand and gravel, including very large, locally derived clasts, deposited in anastomosing channels carved into bedrock. These channels may be several kilometers wide, up to 50+ meters deep, and may cut across other older Ogallala channels with similar geometries. Local tributary fills also occur in the Ogallala. These fills usually are composed of sediments eroded by streams from Miocene and Oligocene sandstone and siltstone formerly exposed along paleovalley sides near the sites of sediment deposition. Up to six volcanic ash deposits have been found in superposed sequences of the Ogallala in the study area. These deposits have blanket, lens, shoestring and irregular geometries. Ash colors are shades of yellow and gray. Shards vary from silt to coarse sand size. Ash deposits are up to 6-7 m thick. Caliche (calcrete and silcrete) occurs throughout the Ogallala but seems to be better developed toward the present top of the formation. The overall geologic history of the Ogallala in the southern Panhandle of Nebraska is one of multiple cycles of erosion and deposition. It is not the history of a single major episode of erosion followed by gradual valley filling that has been reported previously from elsewhere along the Ogallala outcrop belt. (See also W88-04894) (Author's abstract)
W88-04906

SEDIMENTARY PROCESSES AND SEA LEVEL RISE IN TIDAL MARSH SYSTEMS OF CHESAPEAKE BAY,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W88-04939

TIDAL CHANNEL MAINTENANCE: A HYDROLOGICAL FUNCTION OF SALT WATER WETLANDS,
Lehigh Univ., Bethlehem, PA. Fritz Engineering Lab.
For primary bibliographic entry see Field 2L.
W88-04948

RESEARCH IN GLACIAL, GLACIO-FLUVIAL, AND GLACIO-LACUSTRINE SYSTEMS.
Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. Geo Books, Norwich, England, 1982. 318 p. Edited by R. Davidson-Arnott, W. Nickling, and B. D. Fahey.

Descriptors: *Glacial sediments, *Glaciology, *Glacial drift, *Symposium, *Sedimentation, Conferences.

The theme for this sixth symposium was on geomorphology research in glacial, glacio-fluvial, and glacio-lacustrine marine systems. It was kept purposefully broad in order to provide an opportunity for earth scientists from backgrounds incorporating both geography and geology to discuss their common research goals. Sixteen papers were delivered during the two-day event, 14 appear in full in the proceedings and two are represented by abstracts. The symposium and proceedings were both divided into three parts: (1) glacial erosion and deposition, (2) glacio-fluvial sedimentation and processes, and (3) lacustrine and glacio-marine sedimentation. (See W88-05014 thru W88-05027) (Lantz-PTT)
W88-05013

SUBGLACIAL PROCESSES AND THE DEVELOPMENT OF GLACIAL BEDFORMS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W88-05014

TILL HUMMOCK (PROTO-DRUMLIN) AT THE ICE GLACIER BED INTERFACE,
Brock Univ., St. Catharines (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W88-05015

FORMATION OF GLACIAL FLUTINGS IN EAST-CENTRAL ALBERTA,
Alberta Univ., Edmonton. Dept. of Geography.
For primary bibliographic entry see Field 2C.
W88-05016

CONTEMPORARY PUSH MORAINE FORMATION IN THE YOHO VALLEY, BC,
Memorial Univ. of Newfoundland, St. John's.
For primary bibliographic entry see Field 2C.
W88-05017

SUBGLACIAL FLUVIAL EROSION: A MAJOR SOURCE OF STRATIFIED DRIFT, MALASPINA GLACIER, ALASKA,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2C.
W88-05018

DEPOSITIONAL PROCESSES IN THE DEVELOPMENT OF ESKERS IN MANITOBA,
Manitoba Dept. of Energy and Mines, Winnipeg. Mineral Resources Div.
For primary bibliographic entry see Field 2C.
W88-05019

BED FORM DIAGRAMS AND THE INTERPRETATION OF ESKERS,
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W88-05020

HYDRAULIC GEOMETRY OF THE LOWER PORTION OF THE SUNWAPTA RIVER VALLEY TRAIN, JASPER NATIONAL PARK, ALBERTA,
Amoco Canada Petroleum Co. Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 2E.
W88-05021

DERIVATION OF A SUMMARY FACIES SEQUENCE BASED ON MARKOV CHAIN ANALYSIS OF THE CALEDON OUTWASH: A PLEISTOCENE BRAIDED GLACIAL FLUVIAL DEPOSIT,
Ontario Geological Survey, Toronto.
For primary bibliographic entry see Field 2C.
W88-05022

COMPARISON OF SEDIMENTATION REGIMES IN FOUR GLACIER-FED LAKES OF WESTERN ALBERTA,
Illinois Univ. at Chicago Circle. Dept. of Geological Sciences.
N. D. Smith, M. A. Venol, and S. K. Kennedy.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 203-238, 22 fig, 4 tab, 31 ref.

Descriptors: *Glacial sediments, *Sedimentation, *Glacial lakes, *Alberta, Canada, Snowmelt, Lake sediments, Suspended sediments, Streamflow, Glacial streams, Sediment distribution, Coriodis force, Zooplankton, Feces.

Physical characteristics and sedimentation regimes of 4 river-dominated lakes fed by glacial meltwater are described and compared. The 4 lakes (Lower Waterfowl, Peyto, Hector, and Bow) are all located in intermontane valleys in the eastern Canadian Rocky Mountains. Sedimentation patterns are strongly influenced by the type of initial mixing between inflow and lake water. Each of the 4 lakes is characterized by one of three kinds of inflow pattern: homopycnal, underflow, or overflow-interflow. Lower Waterfowl Lake is shallow and unstratified, and inflow carries uniformly low suspended sediment concentrations. Inflow mixing is homopycnal, and fine sediment is dispersed homogeneously through the lake, yielding negligible cross-lake and only weak downlake trends in sedimentation (grain size, deposition rates). In Peyto Lake, high inflowing suspended sediment concentrations result in predominantly underflows, and sediment transport and deposition patterns are largely controlled by bottom topography. Hector and Bow Lakes are both deep and thermally stratified during summer. Inflowing river water, carry-

ing only moderate suspended loads, is less dense than the deep (hypolimnial) lake water and therefore enters the lakes as overflows and shallow interflows which are deflected rightward by the Coriolis effect. Pronounced crosslake as well as downlake sedimentation trends characterize both lakes. Abundant fecal pellets of suspended-sediment-ingesting zooplankton, probably calanoid copepods, occur in Bow Lake. These may comprise an important, though previously unappreciated, mechanism in the dynamics of clay transport and deposition in similar lakes dominated by fine-grained clastic sediments. (See also W88-05013) (Author's abstract)
W88-05023

SITE LOCATION AND INSTRUMENTATION ASPECTS OF A STUDY OF SEDIMENTATION PROCESSES IN A PROGLACIAL LAKE IN SOUTHEASTERN BRITISH COLUMBIA, CANADA,
Toronto Univ. (Ontario). Dept. of Geography.
F. H. Weirich.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 239-260, 10 fig, 7 ref.

Descriptors: *Site selection, *Measuring instruments, *Glacial sediments, *Glacial lakes, *Sedimentation, *British Columbia, *Deltas, *Density currents, Canada, Monitoring, Sediment transport, Glaciohydrology, Lake sediments.

Research conducted on a small, unnamed proglacial lake in southeast British Columbia, Canada, is examined. The study concentrates on continuous monitoring of sediment concentration, currents and temperature in the lake and correlates changes in these parameters with the nature of the sediments being deposited. Specifically, the work is a process study of lake bottom sediments deposited by density currents. A secondary goal is to analyze the entire mesoscale glacial-hydrologic system of which the lake is only a component. The discussion outlines the characteristics of the site, the general nature of the study, and in particular, describes the instrumentation involved. The basin instrumentation consists of a glacier climate station, a central climate station, and a lake-delta climate station. The underwater network, designed to monitor the passage of density currents down the delta foreslope and out into the lake, consisted of 27 sensor packages in a 3 x 3 x 3 array. Each sensor package consisted of (1) a temperature sensor, (2) a photo-optical turbidity sensor, and (3) a suspended sediment sampler system. (See also W88-05013) (Lantz-PTT)
W88-05024

GLACIO-LACUSTRINE SEDIMENTATION ON LOW SLOPE PROGRADING DELTA,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
D. A. Leckie, and S. B. McCann.
IN: Research in Glacial, Glacio-Fluvial, and Glacio-Lacustrine Systems. Proceedings of the 6th Guelph Symposium on Geomorphology, 1980. 1982. p 261-278, 7 fig, 27 ref. NRC Grant No. A5082 and DOE Contract No. 2239-4-154-77.

Descriptors: *Glacial drift, *Glacial sediments, *Sedimentation, *Conne River, *Newfoundland, *Deltas, Canada, Lacustrine sediments, Sand, Clay, Silt, Sediment distribution, Glaciology.

Well exposed sections of lacustrine sediments at Conne River, southern Newfoundland, provide a basis for the development of a model of glaciolacustrine sedimentation in a recessional, valley glacier environment. Three distinct lithological units occur: a lower unit of thin, parallel-bedded, very fine sands, silts and clays; a middle unit of ripple cross-laminated and massive sands interbedded with clayey-silts; and an upper unit of poorly sorted, structureless sands and gravels with crude horizontal stratification. The lower unit represents lake bottom sediments emplaced by two sets of processes. The finely laminated silts were deposited out of suspension from sediments introduced into the lake by inter- and over-flow currents, and the sharp-based, graded beds were deposited by turbidity currents. The sands of the middle unit were deposited on the front of a low slope, prograding delta, subject to slump-induced grain flows. During quiet intervals, finer material settled out of suspension, and a seasonal periodicity is inferred from the couplets of sand and clayey-silt which are present. The coarse upper unit represents the proximal, glaciofluvial, topset beds of the advancing delta. The depositional processes recognized in the sediments suggest a refinement of the existing models of glaciolacustrine sedimentation to incorporate situations where a low slope, prograding glaciofluvial delta advances over glaciolacustrine sediments. (See also W88-05013) (Author's abstract)
W88-05025

COARSE GRAINED FACIES OF GLACIO-MARINE DEPOSITS NEAR OTTAWA, CANADA,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2C.
W88-05026

NEARSHORE DEPOSITS OF THE CHAMPLAIN SEA, NEAR OTTAWA, CANADA,
Reading Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W88-05027

NEAR-BOTTOM CURRENTS AND SUSPENDED SEDIMENT CONCENTRATION IN SOUTHEASTERN LAKE MICHIGAN,
Argonne National Lab., IL. Environmental Research Div.
B. M. Lesht, and N. Hawley.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 375-386, 1987. 10 fig, 24 ref. Great Lakes Environmental Research Laboratory Contract RJ-1-0533.

Descriptors: *Bottom currents, *Turbidity currents, *Sediment transport, *Lake sediments, *Water currents, *Water circulation, *Suspended sediments, *Lake Michigan, Lakes, Sediments, Upwelling, Sediment-water interfaces, Water temperature, Turbidity.

In order to study sediment transport at the edge of the coastal shelf (28 m depth) in southeastern Lake Michigan, an instrumented tripod was used to make continuous observations of horizontal current velocity, temperature, and turbidity within 1 meter of the bottom for 4 weeks during October 1981. The concentration of total suspended material (TSM) 0.9 m above the bottom varied from 1 to 5 milligrams/liter in response to coastal upwelling, surface waves, and currents that on occasion exceeded 0.28 m/sec (0.7 m above the bottom). Advection of the Grand River plume also contributed significantly to the variations in the observed TSM concentration. Currents near the bottom were well-correlated with surface winds and, although upwelling currents transported sediments upslope, the net horizontal sediment flux during the period of observation was west-southwest, almost directly offshore. The magnitude of the horizontal sediment flux was approximately 1,000 times the magnitude of the vertical flux estimated from sediment traps deployed as part of earlier studies. It was inferred that local resuspension occurred roughly 20 percent of the time. The critical mean flow speed (at 0.7 m) for resuspension of the local silty sands was estimated to be about 0.18 m/sec. (Author's abstract)
W88-05037

REPRESENTIVITY OF ORGANIC MATTER VALUES OBTAINED FROM THE STUDY OF COASTAL SEDIMENTS (REPRESENTATIVIDAD DE LOS VALORES DE MATERIA ORGANICA OBTENIDOS EN EL ESTUDIO DE SEDIMENTOS COSTEROS),
Instituto de Ciencias Marinas, Andalucia (Spain).
A. Gomez-Parra, and M. de Frutos.
Investigacion Pesquera IJMDAI, Vol. 51, No. 1, p 107-120, March 1987. 5 fig, 5 tab, 25 ref.

Descriptors: *Organic matter, *Sediments, *Coastal waters, *Bay of Cadiz, *Spain, Coastal sediments, Intertidal areas, Calcination, Organic carbon, Nitrogen, Chemical analysis, Nitrogen compounds, Sampling.

The influence of the analytical method and of sample size on the organic matter values measured in coastal sediments is discussed. Samples were collected in the intertidal zone of the Bay of Cadiz (SW Spain). Weight loss by calcination is compared with the organic carbon and nitrogen content in samples of different sizes. Based on loss of weight by calcination proved inadequate for sediments with high carbonate contents, or where fine-grained fractions predominated. Weight loss values were 200% higher than organic matter concentrations obtained by chemical analysis (organic C and N). Moreover, significant differences were observed between the organic matter of adjacent sediment samples. This difference is attributable to the existence of microheterogeneities in the sediment composition. The estimated minimum surface for representative sampling of the sedimentary environments must be larger than 0.40 sq m. (Author's abstract)
W88-05043

MASS TRANSFER OF SODIUM CHLORIDE IN SIMULATED CRYSTALLIZING POND DURING THE RAINFALL PERIOD,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2K.
W88-05068

COMMON BEHAVIORAL TRENDS IN ALLUVIAL CANALS AND RIVERS,
S. V. Chitale.
Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 1, p 54-62, January 1988. 1 tab, 13 ref, 1 append.

Descriptors: *Hydraulics, *River flow, *Canals, *Alluvial channels, *Channel morphology, *Channel erosion, Erosion, Channel flow, Flow, Channels, Morphology, Sediment transport, Bank erosion, Hydraulic structures, Lacey formula, Hydraulic structures.

Two trends in the adjustment of shape and slope of alluvial canals and rivers are identified. Using the concept of divergence from Lacey, these trends are quantified and reveal that the width, depth, and slope of alluvial channels are interdependent. The relationships evolved provide a simple procedure for the design of alluvial canals covering a wide range of bed material characteristics, sediment transport rate, and resistivity to bank erosion. Evaluation of the response of rivers to hydraulic structures and design of river link canals are also rendered easy with the aid of the two newly quantified trends. (Author's abstract)
W88-05076

UNCERTAINTY IN SUSPENDED SEDIMENT TRANSPORT CURVES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, and S. Nassri.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 1, p 63-74, January 1988. 9 fig, 3 tab, 7 ref.

Descriptors: *Sediment transport, *Hydraulics, *River flow, *Suspended sediment, Astore River, Indus River, India.

The uncertainties implicit in suspended sediment transport curves were examined, and the practice of using sediment load versus discharge is shown to be misleading, since the goodness of fit implied by this relation is spurious. The bases for equations to derive best estimates and confidence limits for suspended sediment concentration versus discharge were developed. The correct equation involves the regression of concentration versus discharge. The findings were applied to a large river (Indus) and a small river (Astore). The confidence ranges should

be used as indicators of uncertainty/sensitivity in design. (Cassar-PTT)
W88-05077

SEASONAL AND LONGITUDINAL VARIATIONS IN APPARENT DEPOSITION RATES WITHIN AN ARKANSAS RESERVOIR,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5C.
W88-05097

2K. Chemical Processes

SURFACE COMPLEX MODEL FOR ADSORPTION OF TRACE COMPONENTS FROM WASTEWATER,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-04588

GROUNDWATER GEOCHEMISTRY OF AQUIFER THERMAL ENERGY STORAGE: LONG-TERM TEST CYCLE,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. A. Perlinger, J. E. Almendinger, N. R. Urban, and S. J. Eisenreich.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2215-2226, December 1987. 13 fig, 4 tab, 33 ref. DOE Grant No. DE-AC06-76RL0 1830.

Descriptors: *Aquifers, *Geochemistry, *Water temperature, *Groundwater storage, Seasonal variation, Groundwater quality, Mineralization, Feasibility studies.

Groundwater chemistry was monitored during a test of the feasibility of long-term (180-day) aquifer thermal energy storage. From a source well 92,100 cu m of groundwater was pumped, heated (110 C), and injected into the aquifer consisting primarily of quartz sandstone, with lesser amounts of dolomite, feldspar, and clay minerals. Softening the water prior to heating effectively prevented mineral precipitation in the heat exchanger and injection well. Recovered water was saturated with respect to quartz, dolomite, and calcite, which indicates that quartz, dolomite, and calcite dissolved during aquifer storage. Loss of sodium in the aquifer is thought to result from mixing of ambient groundwater (up to 27%) with heated, injection water. Upon subsequent cycles, softening requirements are expected to decrease, and less mineral dissolution is expected to occur during aquifer storage, resulting in negligible changes in the hydraulic characteristics of the aquifer. (Author's abstract)
W88-04602

ANNUAL CARBON DIOXIDE CYCLE IN A MONTANE SOIL: OBSERVATIONS, MODELING, AND IMPLICATIONS FOR WEATHERING,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2G.
W88-04606

SOLUTE TRANSPORT IN UNDISTURBED COLUMNS OF AN AGGREGATED TROPICAL SOIL: PREFERENTIAL FLOW EFFECTS,
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W88-04630

KINETICS AND MECHANISMS OF POTASSIUM RELEASE FROM SANDY MIDDLE ATLANTIC COASTAL PLAIN SOILS,
Delaware Univ., Newark. Dept. of Plant Science.
For primary bibliographic entry see Field 2G.
W88-04633

ADSORPTION AND OXIDATION OF PHENOLIC COMPOUNDS BY IRON AND MANGANESE OXIDES,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W88-04634

SIMPLE KINETIC FRACTIONATION OF REACTIVE ALUMINUM IN SOIL 'SOLUTIONS',
Vermont Univ., Burlington. Dept. of Physics.
For primary bibliographic entry see Field 5B.
W88-04635

KINETIC STUDY OF CITRATE EFFECTS ON ORTHOPHOSPHATE SOLUBILITY IN AN ACIDIC, MONTMORILLONITIC SOIL,
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W88-04636

MOVEMENT OF MANGANESE-54 IN CALCAREOUS SOILS AS AFFECTED BY LEACHING SOLUTION, LIME CONTENT, SALINIZATION, AND STERILIZATION,
Iraqi Atomic Energy Commission, Baghdad. Nuclear Research Center.
A. A. Fahad.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1487-1492, November-December 1987. 7 fig, 2 tab, 17 ref.

Descriptors: *Manganese, *Calcareous soils, *Leaching, *Lime, *Salinity, Soil properties, Spectrometry, Calcium chloride, Loam, Sand, Soil properties, Soil chemistry.

Movement of 54-Mn was investigated in calcareous soil columns (untreated, partially depleted lime, salinized, and sterilized) leached with 0.05 mol CaCl2/l followed by 0.03 mol EDTA/l (ethylenediaminetetraacetic acid). Manganese was monitored along the soil columns using gamma spectrometry and measured in the effluent during the leaching course (80-120 d). Results indicated that the leaching with CaCl2 for 45 d left 63, 32, and 10% of the applied Mn in the upper 0.5 cm of the silty clay, loam, and loamy sand soils, respectively, with no Mn detected below 5.0 cm. Conversely, leaching with EDTA for 4 d resulted in a nearly uniform distribution of Mn in the 20-cm soil columns. The various soil treatments caused a reduction in the retention capacity of the three soils for Mn with the maximum reduction occurring in the soils with partially depleted lime. In most cases, leaching with CaCl2 for 45 d produced no Mn in the column effluent except negligible amounts of Mn that were displaced from the sterilized and 50 g lime/kg columns. However, Mn emerged in the effluent immediately after EDTA application and continued until the end of the leaching course. The shape and the position of the breakthrough curves varied depending on the specific soil treatment. (Author's abstract)
W88-04637

MASS LOSS AND NUTRIENT CHANGES IN DECOMPOSING UPLAND OAK AND MESIC MIXED-HARDWOOD LEAF LITTER,
Tennessee Valley Authority, Oak Ridge.
For primary bibliographic entry see Field 2I.
W88-04650

IMPACTS OF ACID ATMOSPHERIC DEPOSITION ON WOODLAND SOILS IN THE NETHERLANDS: I. CALCULATION OF HYDROLOGIC AND CHEMICAL BUDGETS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 5C.
W88-04651

IMPACTS OF ACID ATMOSPHERIC DEPOSITION ON WOODLAND SOILS IN THE NETHERLANDS: II. NITROGEN TRANSFORMATIONS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 5C.
W88-04652

IMPACTS OF ACID ATMOSPHERIC DEPOSITION ON WOODLAND SOILS IN THE NETHERLANDS: III. ALUMINUM CHEMISTRY,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
For primary bibliographic entry see Field 5C.
W88-04653

SALINE WATER OCCURRENCE WITHIN THE TERTIARY SPARTA SAND AND COCKFIELD AQUIFERS OF WASHINGTON COUNTY, MISSISSIPPI,
Mississippi Bureau of Land and Water Resources, Jackson.
For primary bibliographic entry see Field 2F.
W88-04685

CHEMICAL SPECIATION APPROACH TO EVALUATE WATER QUALITY PROBLEMS IN THE BLACKBIRD MINING DISTRICT, IDAHO,
Idaho Univ., Moscow. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-04737

ADSORPTION, DESORPTION, AND ISOTOPIC EXCHANGE OF CADMIUM ON ILLITE: EVIDENCE FOR COMPLETE REVERSIBILITY,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geochemistry.
For primary bibliographic entry see Field 5B.
W88-04860

GEOLOGIC CONTROLS AND RADON OCCURRENCE IN NEW ENGLAND,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
F. R. Hall, E. L. Boudette, and W. J. Olszewski.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 15-30, 1 fig, 2 tab, 19 ref.

Descriptors: *Radon, *Geochemistry, *Geology, *Water pollution sources, Uranium, Soil contamination, Maine, New Hampshire, Groundwater pollution, Granite, Pumping, Aquifers, Groundwater movement, Radium.

The predictability of radon production from bedrock is anticipated by a combination of uranium endowment and distribution of uranium into mineral phases. The authors have synthesized a map of New England at 1:1,000,000-scale which shows 11 rock units. These units are discriminated by geologic factors including measured uranium distribution. The average uranium content varies from very low (< 1ppm) to very high (> 29 ppm). Uranium in rocks and in soils derived from a rock, and radon in air and groundwater in the environment should show a direct correlation in most instances. This observation has been borne out by information assembled from air and water sampling particularly in Maine and New Hampshire. Other controls that influence radon production relate to mobility of uranium in groundwater. Transport can lead to a secondary enrichment of uranium (or radium) which contributes to local high levels of radon. Two-mica granite provides an excellent example because the uranium is nearly all labile, and high radon values occur in groundwater associated either with pegmatite or deposits of secondary uranium minerals. Alkalic or calc-alkalic granite is also high in uranium, but it tends to be stabilized within accessory minerals. Thus, the radon levels associated with these rocks are not as high as in two-mica granite. Hydrologic response to a pumping well also has a role in determining radon content of well water. Altering geochemical conditions in the flow field and aquifer stress providing increased rates of radon transport with induced groundwater flow appear to be the primary controls. (See also W88-04980) (Author's abstract)
W88-04982

RELATION BETWEEN NATURAL RADIONUCLIDE ACTIVITIES AND CHEMICAL CONSTITUENTS IN GROUND WATER IN THE NEWARK BASIN, NEW JERSEY,
Geological Survey, Trenton, NJ.
Z. Szabo, and O. S. Zapecza.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 283-308, 9 fig, 2 tab, 32 ref.

Descriptors: *Chemical analysis, *Groundwater quality, *Newark Basin, *New Jersey, Radioactivity, Hydrologic properties, Hydrogen ion concentration, Alkalinity, Dissolved oxygen, Conductivity, Alpha radiation, Uranium, Radon, Radium, Oxidation, Chemical properties, Iron, Manganese, Barium, Stromtium, Chemical analysis, Sulfates.

The US Geological Survey, in cooperation with the New Jersey Department of Environmental Protection, Division of Water Resources, is conducting a study to determine the occurrence and distribution of naturally occurring radionuclides in groundwater in the Newark Basin, New Jersey, and to identify other aqueous chemical constituents that may be associated with these radionuclides. Water samples were collected by the Geological Survey in 1985 and 1986 from 260 groundwater sites areally distributed throughout the Newark Basin. Specific conductance, pH, alkalinity, dissolved oxygen, Eh (oxidation-reduction potential), and water temperature were measured on site. Gross alpha-particle radiation activities ranged from less than 0.1 to 124 pCi/l; uranium activities ranged from 0.1 to 40 pCi/l; 226-Ra activities ranged from <0.01 to 22.5 pCi/l; and 222-Rn activities ranged from 71 to 15,900 pCi/l. Where gross-alpha radiation in reducing waters was high, 226-Ra activities were elevated; however, where gross-alpha radiation in oxidizing waters was high, uranium activities were elevated. These results suggest that oxidation-reduction potential is an important control on 226-Ra and uranium concentrations in groundwater. Elevated activities of 226-Ra or uranium were not found exclusively in any one chemical class of groundwater; however, elevated levels of 226-Ra are absent from sulfate-dominated waters. In several instances, 226-Ra activities in excess of 1 pCi/l were associated with anomalously high levels of iron (11,000 micrograms/l), manganese (1,600 micrograms/l), and barium (1,300 micrograms/l). Uranium activities in excess of 4 pCi/l were locally associated with strontium concentrations as high as 5,100 micrograms/l. No definitive relation could be determined between concentrations of 222-Rn and 226-Ra in the groundwater. (See also W88-04980) (Lantz-PTT)
W88-04999

RADIUM, RADON AND URANIUM ISOTOPES IN GROUNDWATER FROM CAMBRIAN-ORDOVICIAN SANDSTONE AQUIFERS IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W88-05004

ADSORPTION AND DESORPTION OF ZN, CU, AND CR BY SEDIMENTS FROM THE RAISIN RIVER (MICHIGAN),
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W88-05036

MASS TRANSFER OF SODIUM CHLORIDE IN SIMULATED CRYSTALLIZING POND DURING THE RAINFALL PERIOD,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Chemical Engineering.
T.-C Huang, R.-S. Juang, and T.-H. Huang.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 39, No. 2, p 93-106, 1987. 11 fig, 2 tab, 11 ref.

Descriptors: *Leaching, *Weathering, *Brines, *Sodium chloride, *Rainfall, *Crystallization, *Ponds, *Mass transfer, Salt, Solute transport, Solubility, Convective mass transfer coefficient, Dissolution mass transfer coefficient.

The mass transfer equation describing the transport phenomena of sodium chloride is derived for a simulated crystallizing pond during the rainfall period. According to the theoretical and experimental results, the dissolution rate of NaCl is shown to be controlled by the combination of salt transport including the diffusion and convection of solute in solution and a surface dissolution reaction including the desorption and surface diffusion of solute. It is found that both the dissolution and convective mass transfer coefficients are proportional to the total rainfall quantity and inversely proportional to the brine depth. The variation of dissolution mass transfer coefficients to the total rainfall quantity and brine depth is correlated from the experimental results. Correlation of the convective mass transfer coefficient is also obtained by using the numerical solution of the mass transfer equation. (Author's abstract)
W88-05068

2L. Estuaries

EFFECTS OF LIGHT AND INTERTIDAL POSITION ON SEEDLING SURVIVAL AND GROWTH IN TROPICAL TIDAL FORESTS,
Australian Inst. of Marine Sciences, Townsville.
T. J. Smith.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 110, No. 2, p 133-146, August 25, 1987. 4 fig, 2 tab, 32 ref.

Descriptors: *Plant physiology, *Flooding, *Tropical regions, *Forests, *Wetlands, *Tidal wetlands, Tidal floods, Vegetation, Seedlings, Light, Population density.

Reciprocal transplant experiments were used to study the effects of tidal inundation and light level on growth and survival of four species of mangroves in Australia: Avicennia marina (Forsk.) Vierh., Bruguiera gymnorrhiza (L.) Lam., Ceriops tagal C.T. White, and Rhizophora stylosa Griff. Seedlings were planted in the high or low intertidal and in light gaps or under the shade of a closed canopy. Survival and growth of the seedlings were monitored for 30-36 months. Significant differences in survival were found among species, between intertidal zones and due to light level. Averaged across intertidal zones and light level, survival was greatest for Rhizophora and decreased in the order Ceriops, Avicennia, and Bruguiera. For all species survival was greater ($P < or = 0.001$) in the high than in the low intertidal treatment, regardless of light level. Within the high intertidal all species survived better in light gaps than under the canopy. Relative growth of Rhizophora stylosa, Avicennia marina, and Ceriops tagal were greater in the high versus low intertidal and in gaps versus under the canopy. For Bruguiera gymnorrhiza, growth was not significantly different between gap and canopy or high and low intertidal. Although Avicennia marina, Bruguiera gymnorrhiza, and Rhizophora stylosa survived and/or grew best in the region where it is most abundant, yet even there, it was out-performed by the former three species. These results indicate that the species zonation patterns often observed across the intertidal cannot be explained by physiological adaptation alone. Factors such as propagule dispersal, competition and predation on propagules may also be important. (Author's abstract)
W88-04509

DETRITUS CYCLING IN A SHALLOW COASTAL LAGOON IN NATAL, SOUTH AFRICA,
Natal Univ. (South Africa). Oceanographic Research Inst.
M. H. Schleyer, and G. A. Roberts.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 110, No. 1, p 27-40, August 20, 1987. 3 fig, 3 tab, 30 ref.

Descriptors: *Detritus, *Shallow water, *Lagoons, *Natal, *Estuaries, *Cycling nutrients, Silting, Reeds, Food chain, Litter, Organic matter.

Heavy siltation is characteristic of most of Natal's estuaries as a result of agricultural mismanagement. A reduced freshwater input, invasion by the reed Phragmites australis (Cav.) Trin ex Steudel, and anaerobic conditions, caused by an inability to cope with the detritus load, are frequently concomitant factors. The Siyaya system is a typical case and was chosen for a catchment rehabilitation study to establish whether restorative action would effect an improvement in the lagoon. Conditions related to the detritus food chain were studied in the lagoon as part of the program, as a response to improvements in the system are expected to be manifested first at this level. Measurements were made on various physical conditions, the rates of leaf litter input and labelled leaf litter decomposition, and the detritus and microbial levels. The results provide baseline data for future comparative studies and reveal that litter input (1.61 kg/sq m/a) exceeds the estimated mineralization rate. Anaerobic conditions prevent the development of a population of secondary consumers to utilize the excess detritus and the reeds prevent it from being flushed from the system by floods. Organic matter thus accumulates in the lagoon and this is portrayed in a simple budget of carbon flux through the detritus food chain. Eradication of the reed beds appears to provide a key to rehabilitation, but this action would initially exacerbate the problem by increasing the detritus load. Aeration is suggested as a means of overcoming this problem. (Author's abstract)
W88-04510

SPATIAL DISTRIBUTION AND BIOMASS OF SEAGRASSES IN THE BAYS OF EBRO DELTA (DISTRIBUCION ESPACIAL Y BIOMASA DE LAS FANEROGAMAS MARINAS DE LAS BAHIAS DEL DELTA DEL EBRO),
Barcelona Univ. (Spain). Dept. de Ecologia.
M. Perez, and J. Camp.
Investigacion Pesquera IJMDAI, Vol. 50, No. 4, p 519-530, December 1986. 7 fig, 3 tab, 14 ref.

Descriptors: *Ecological distribution, *Distribution patterns, *Biomass, *Bays, *Seagrasses, Alfaques Bay, Fangar Bay, Spain, Estuaries, Vegetation, Productivity, Remote sensing, Seasonal variation.

Three seagrasses (Cymodocea nodosa, Zostera noltii and Ruppia cirrhosa) cover almost 100% of the surface of shallow sediments of Fangar Bay and 26% of Alfaques Bay (Rio Ebro delta, Spain). Vegetative cover, distribution of communities, and the annual cycle of biomass were estimated using aerial photography, and in situ measurements allowed the estimation of the contribution of seagrasses to the productivity of the bay. The contribution of seagrasses is greater in Fangar Bay than in the Alfaques Bay. (Author's abstract)
W88-04542

SECCHI DISK VISIBILITY, CHLOROPHYLL A AND PARTICULATE ORGANIC MATTER IN THE PONTEVEDRA ESTUARY (NW OF SPAIN) (VISIBILIDAD DEL DISCO DE SECCHI, CLOROFILA A Y MATERIA ORGANICA PARTICULADA EN LA RIA DE PONTEVEDRA (NO DE ESPANA)),
Instituto de Investigacones Pesqueras de Vigo (Spain).
F. G. Figueiras, and F. X. Niell.
Investigacion Pesquera IJMDAI, Vol. 50, No. 4, p 607-637, December 1986. 10 fig, 4 tab, 21 ref.

Descriptors: *Secchi disks, *Chlorophyll a, *Organic matter, *Ria of *Turbidity, *Ponteverda estuary, *Spain, *Algae, *Algal blooms, Transparency, Phytoplankton, Upwelling, Saline water intrusion, Seasonal variation, Water circulation.

The annual cycle of phytoplankton, estimated using chlorophyll a, and of the particulate organic matter in the Pontevedra estuary, are controlled by oceanic intrusions of North Atlantic Central water (N.A.C.W.). This water mass supplies nutrients that allow sporadic blooms during the growth season, from February-March to November. Runoff has little importance in this control but

excessive flow can prevent the bloom by means of diffusion losses. The circulation is shaped by the N.A.C.W. intrusions, and an important gyre is located in the center of the ria. Effluent from a paper mill has a very noticeable impact on the inner zone by introducing concentrations of particulate organic matter. Most of this material sink very rapidly. Water transparency is controlled by the same processes. The N.A.C.W. intrusions bring water of greater transparency, which becomes more turbid with phytoplankton growth. The spatial distribution of turbidity is clearly controlled by the circulation of the estuary. (Author's abstract)
W88-04544

FLOOD SIMULATION IN THE TIDAL DELTA OF THE MEKONG RIVER BY THE SSARR MODEL,
Asian Inst. of Tech., Bangkok (Thailand).
T. Tingsanchali, and N. D. Lien.
Water Resources Journal, No. 151, p 30-38, December 1986. 10 fig, 1 tab, 11 ref.

Descriptors: *Flooding, *Simulation analysis, *Hydrologic models, *Mekong River, *Streamflow Synthesis and REservoir Regulation model, Tidal floods, Model studies, Mathematical analysis, Floods, Mathematical models, Bassac River, Vaico River, Vietnam, Cambodia, Flood spreading.

The SSARR (Streamflow Synthesis and Reservoir Regulation) model is applied to simulate flood levels in the Mekong river delta. The Mekong and Bassac Rivers which are two main rivers and the Vaico river are interlaced together with canals and flood plains with storage. The flow exchanges between these rivers, and the tidal influences in their estuarial reaches make it necessary to utilize the backwater mode of the SSARR model in the simulation. In addition to the backwater mode, the diversion algorithm of the SSARR model is also used to take into account the overbank flow conditions. Since the river storages during the flood periods are considerable, the rivers have been divided into several storage reaches or reservoirs. The flow between these storage reaches depends on the water level differences between each pair. Moreover, the various flood plain storages are also represented by a network of interconnected storage reaches or reservoirs. The upstream boundary condition is the discharge in the Mekong river at Phnom Penh (Cambodia), and the downstream boundary conditions are the tides at the mouths of the three rivers. Rainfall over the study areas is also considered as input to the model. In general, very close agreement is obtained in the calibration and verification except at the stations Can Tho and My Thuan (Vietnam) where tidal influences are significant. However, good results are obtained for the envelope of high tides at these two stations. Sensitivity analysis is made to determine the effects of the overbank flow parameters, and the exchange flow parameters on the flow in the rivers. More data collection of delta discharges and water levels is recommended for the future to improve the existing backwater relationship for better simulation of tidal fluctuation in the estuarial reaches of the delta. (Author's abstract)
W88-04553

POLYCHLORINATED BIPHENYL-TRANSPORT RATES IN THE UPPER HUDSON RIVER, NEW YORK, 1977-83,
Geological Survey, Albany, NY.
For primary bibliographic entry see Field 5B.
W88-04561

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 1: A REVIEW OF ESTUARY HYDRAULICS AND TRANSPORT AS APPLIED TO RIVERS TRIBUTARY TO LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04701

ANALYSIS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 2: LITTORAL DRIFT PROCESSES AT ESTUARY MOUTHS - A CASE STUDY AT OLD WOMAN CREEK IN LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04702

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 3: A LATERALLY AVERAGED MODEL OF MOMENTUM AND ENERGY TRANSPORT WITH APPLICATION TO SEICHE HYDRAULICS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04703

ASPECTS OF GREAT LAKES SEICHE AFFECTED ESTUARY TRANSPORT. VOLUME 4: THE EFFECT OF LAKE ERIE/SANDUSKY BAY SEICHE OSCILLATIONS ON THE FORMATION OF SANDUSKY BAY,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-04704

MODELING WATER QUALITY VARIABLES OF THE POTOMAC RIVER AT THE ENTRANCE TO ITS ESTUARY, PHASE I: TREND AND SEASONALITY,
George Washington Univ., Washington, DC. International Water Resources Inst.
For primary bibliographic entry see Field 5B.
W88-04707

INTERNATIONAL SYMPOSIUM ON THE MOST IMPORTANT UPWELLING AREAS OF WESTERN AFRICA (CAPE BLANCO AND BENGUELA)(SIMPOSIO INTERNACIONAL SOBRE LAS AREAS DE AFLORAMIENTO MAS IMPORTANTES DEL OESTE AFRICANO (CABO BLANCO Y BENGUELA)).
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
Volume 2, 1985. 525 p. Edited by C. Bas, R. Margalef, and P. Rubies.

Descriptors: *Symposium, *Upwelling, *Cape Blanco, *Cape Benguela, *Ocean circulation, *Oceanography, Conference, Ocean bottom, Primary productivity, Benthic environment, Fisheries, Fish populations.

This symposium discusses the mechanisms and physical and biological processes that relate to ocean upwelling at Capes Blanco and Benguela, off the West African coast. The two major section headings in this second volume are: (1) bottom ecosystems, and (2) living resources. Paper cover topics from benthic production and benthic systems to fish abundance and fisheries in upwelling areas. (See W88-04709 thru W88-04721) (Lantz-PTT)
W88-04709

BENTHIC PRODUCTION AND PROCESSES OFF BAJA CALIFORNIA, NORTHWEST AFRICA AND PERU: A CLASSIFICATION OF BENTHIC SUBSYSTEMS IN UPWELLING ECOSYSTEMS,
Brookhaven National Lab., Upton, NY. Oceanographic Sciences Div.
G. T. Rowe.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 589-612, 7 fig, 8 tab, 42 ref. DOE Contract No. DE-AC02-76CH00016.

Descriptors: *Baja California, *Peru, *Africa, *Coastal waters, *Benthic production, *Upwelling, Productivity, Oxygen, Biomass, Organic matter, Ecosystems, Ocean circulation, Mexico, Crabs, Bacteria.

Estimates of the standing stocks, secondary production and metabolism of the benthos have been compared in the coastal upwelling ecosystems off northwest Africa, Baja California, and southern Peru. Northwest Africa is characterized by shelf break upwelling and as a result standing stocks, macrobenthic production and sediment organic matter are highest out at the shelf-slope boundary. Sedimentary microbial activity and biomass are highest nearshore in the dynamic zone where aeolian silt and sand are being blown into the sea from the Sahara Desert. Baja California is dominated by the red crab, Pleuroncodes planipes, having high rates of growth and metabolic utilization of organic matter, both on bottom and in the water. Peru benthos and metabolism are very different from the above areas because of the low oxygen concentrations in the bottom water. Organic matter is far higher in the sediment and heterotrophic metabolism is principally anaerobic rather than aerobic. A normal offshore benthic fauna is replaced by a mat of sulfur bacteria with unknown production and metabolic rates. Benthic subsystems in upwelling ecosystems can be placed in two categories: those overloaded with organic matter, depleted of oxygen and dominated by sulfate reduction and those that are not overloaded and remain aerobic. Peru and southwest Africa typify overloaded systems whereas NW Africa and Baja California are examples of aerobic systems. Although benthic metabolism and inorganic nutrient regeneration are high in both types of subsystems, all upwelling ecosystems, with their dynamic open boundaries, export organic particulate matter and import inorganic nutrients at rates that are far in excess of that consumed or produced by benthic metabolism. (See also W88-04709) (Author's abstract)
W88-04710

BENTHIC SYSTEM UNDERLYING THE NW AFRICA UPWELLING REGION (EL SISTEMA BENTONICO SITUADO BAJO EL AFLORAMIENTO DEL NO DE AFRICA),
Malaga Univ. (Spain). Dept. de Ecologia.
F. X. Niell.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 613-625, 6 fig, 43 ref.

Descriptors: *Upwelling, *Benthic environment, *Coastal waters, Africa, Productivity, Ocean circulation, Water currents, Nutrients, Sediments.

Upwelling systems influence the bottom environment in several ways. In the NW Africa area, the influence of high pelagic production is less clear than in other upwelling areas, because of local dispersion of sinking matter due to the presence of local currents, and perhaps, because of the intensity of upwelling is not similar to those of California and Benguela. However, the Sahara region shows a discontinuity in the values of some variables when compared with contiguous geographical areas, the differences consisting in an increase of sedimented material, both biotic and abiotic (insoluble nutrients and metals) in the bottom. Paleoecological displacement of the upwelling nucleus is discussed. (Author's abstract)
W88-04711

SOME PECULIARITIES OF THE GROWTH OF FISH OFF THE WESTERN COASTS OF AFRICA,
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
N. Y. Lipskaya.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 683-689, 1 fig, 2 tab, 26 ref.

Descriptors: *Fish physiology, *Growth, *Coastal waters, *Africa, Upwelling, Growth kinetics, Growth rates.

An analysis is given of the growth duration and growth rates of some species of fish - Trachurus trachurus L., Tr. trachurus capensis Castelnau, Tr. trecae Cadenat, Engraulis encrsicholus (L.), Mullus barbatus L., M. surmuletus L., Pseudupeneus cyclostomus Lac.) - in the productive upwelling zones off the western coast of Africa (10-12 N and 10-30 S). Causes responsible for the growth periodicity and the formation of annual rings on the registering systems are discussed. Correlation is given with the peculiarities of the growth of the same species inhabiting other areas characterized by different environmental conditions. (See also W88-04709) (Author's abstract)
W88-04712

DEMERSAL COMMUNITIES STRUCTURE (FISHES) IN THE UPWELLING AREAS OFF WESTERN AFRICA (SAHARA AND NAMIBIA)(LAS COMUNIDADES DE PECES DEMERSALES DEL AFLORAMIENTO DE AFRICA OCCIDENTAL (SAHARA Y NAMIBIA)),
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
B. Roel, J. Rucabado, D. Lloris, and J. Lleonart.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 691-699, 2 fig, 2 tab, 13 ref.

Descriptors: *Fish populations, *Upwelling, *Africa, *Coastal waters, Data interpretation, Species diversity, Ecological distribution, Cephalopods.

The structure of demersal communities (fish and cephalopods) in upwelling areas off western Africa has been studied from data obtained in three cruises carried out on the Saharan grounds and two on the Namibian grounds. Two data approaches have been used: classification of the samples after the presence/absence matrix by the UPGMA algorithm comparison of the faunal listings. The results of the first approach confirm the higher response of structure to non-topographic parameters in the Namibian region, whereas bottom topography is the main parameter responsible for community structure in the Sahara region. The higher species abundance in Sahara is also related to the lower ecological maturity level (higher instability ratio) for the Namibian region. Both areas show high biological production. The 'species abundance spectrum' for the Sahara region is similar in both depth ranges studied (90 to 200 m; overall range in the Sahara 14 to 456 m), whereas there is a higher dissimilarity in Namibia (90 to 200 m; overall range in Namibia 70 to 800 m depth), denoting a higher response to environmental fluctuation and other factors. This fact is also confirmed by the cluster analysis. (See also W88-04709) (Author's abstract)
W88-04713

SPECIES INTERACTIONS AND STOCK ASSESSMENT. SOME IDEAS AND APPROACHES,
Food and Agriculture Organization of the United Nations, Rome (Italy).
J. F. Caddy.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 703-734, 9 fig, 2 tab, 42 ref.

Descriptors: *Ecosystems, *Fish populations, *Fisheries, *Upwelling, *Africa, *Food web analysis, Food habits, Food chains, Ecological distribution, Biomass, Species diversity, Statistical analysis, Trophic level, Fish food.

Defining the trophic linkages between the main components of fisheries ecosystems is an important strategic consideration for fisheries research and management, especially for ecosystems subject to dramatic changes in species dominance, such as in areas of upwelling like those on the West Coast of Africa. A basic approach to food web analysis is proposed, in which the main resident and migratory species in an area are characterized, together with the species assemblages they make up and their trophic interrelationship. Several simple indices are proposed for characterizing areal and dietary overlap. This early phase may be achieved in the course of routine stock assessment work, especially during fisheries surveys for biomass estimation. The trophic interrelationships between the macroscopic components of the system, by species and relevant size/age categories, are most easily characterized in a contingency table, and a qualitative food web can then be constructed, showing trophic linkages and seasonally weighted estimates of the proportions of food coming from each prey component. In an attempt to define approximate rates of flow between species in a given food web, analysis of a limited set of feeding rate data for demersal fish in the literature was the basis of a multiple regression analysis of feeding rate as a function of body weight and environmental temperature. This was used to obtain rough orders of size for biomass transfer between food web components. (See also W88-04709) (Author's abstract)
W88-04714

CEPHALOPOD FISHERIES IN TWO UPWELLING AREAS OFF THE WEST COAST OF AFRICA: A COMPARISON (COMPARACION DE LAS PESQUERIAS DE CEFALOPODOS DE DOS AREAS DE AFLORAMIENTO DE LA COSTA OCCIDENTAL AFRICANA),
Instituto de Investigacones Pesqueras de Vigo (Spain).
A. Guerra, and P. Sanchez.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 749-760, 2 tab, 39 ref.

Descriptors: *Cephalopods, *Upwelling, *Africa, Fisheries, Ecosystems, Oxygen, Coastal waters, Species diversity, Ecological distribution.

Cephalopod fisheries in the upwelling areas off Northwest African coast and in the Northern Benguela Current (SW Africa) are compared. Both areas have maintained heavy fisheries since long ago, but commercial catches of Cephalopods are sizeable only in the northern area. To understand the possible reasons that could explain this difference, hydrographical features, species composition, some biological characteristics of species, and fishery strategies of fleets in these areas have been analyzed. Low oxygen concentrations in shallow waters of the Namibian and South African shelf seemed to be the most important limiting factor for the development of populations of species belonging to the families Sepiidae and Octopodidae. Oceanic cephalopods, mainly belonging to the family Ommastrephidae, are abundant in this area. Lack of significant catches of these species may be due to the lack of appropriate or directed fisheries. (See also W88-04709) (Author's abstract)
W88-04715

FISHERY RESOURCES OF THE UPWELLING AREA OFF NW AFRICA (LOS RECURSOS PESQUEROS DEL AREA DE AFLORAMIENTO DEL NO AFRICANO),
Instituto Espanol de Oceanographia, Tenerife (Spain). Centro Costero de Canarias.
J. Bravo de Laguna.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 761-798, 16 fig, 15 tab, 72 ref.

Descriptors: *Fisheries, *Upwelling, *Africa, Species diversity, Hake, Shrimp, Cephalopods, Squid, Cuttlefish, Octopus, Crustaceans, Commercial.

The upwelling area off NW Africa contains important fisheries that yield more than 2.2 million metric tons. From the economic and social point of view, the most important groups of species are the hakes, crustaceans, cephalopods, pilchards and sea breams. The European hake is caught together with the deep water rose shrimp and other crustaceans by an artisanal inshore and an offshore fishing fleet, between 35 30'N and 24 N. Production models indicate that the hake is fully exploited. There are not enough data to assess the level of exploitation of the deep water rose shrimp. The Senegalese hake is caught together with the black hake to the south of Villa Cisneros (23 30'N). The main fishing countries have been Spain, Portugal and the Soviet Union. The last assessments indicate the fishing mortality rate in 1976 ($F = 0.7$) is higher than the optimal one ($F = 0.6$). The most important crustacean is the deep water rose shrimp. It is caught jointly with the European hake and is the other target species of the fresh fish trawler fleet to the north of Cape Blanc. There is not enough information to know its state of exploitation. The cephalopods fishery has as target one species of octopus, six cuttlefishes and two squids. The main fishing countries are Spain, Korean Republic, Japan, Morocco and Mauritania. (See also W88-04709) (Lantz-PTT)
W88-04716

FEEDING OF FISH LARVAE (F. SOLEIDAE AND F. CARANGIDAE) IN THE UPWELLING REGION OFF NW AFRICA: A COMPARATIVE STUDY (ESTUDIO COMPARATIVO DE LA ALIMENTACION DE LARVAS DE PECES (F. SOLEIDAE Y F. CARANGIDAE) EN LA REGION DE AFLORAMIENTO DEL NO DE AFRICA),
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
J. Izquierdo.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 989-1003, 6 fig, 15 ref.

Descriptors: *Fish larvae, *Food habits, *Upwelling, *Africa, Qualitative analysis, Quantitative analysis, Fish food, Copepods.

The ATLOR III cruise, made in March-April 1973 in the upwelling area off the Saharan coast, provided the material for this study. Larvae belonging to two families of fishes (Soleidae, represented by two species, i.e., Microchirus ocellatus and M. azevia, and Carangidae, represented by one species, Trachurus trachurus) have been considered. Their feeding habits during their larval life, especially during the early stages, were studied. Qualitative and as quantitative differences between these two kinds of larvae were observed. Carangid larvae fed mainly on copepodites and adult copepods belonging to the Cyclopoid and Calanoid groups, whereas Soleid larvae fed mainly on Harpacticoid copepods. At the same time, differences in the mouth opening between the two kinds of larvae were found. (See also W88-04709) (Author's abstract)
W88-04717

LIVING RESOURCES OF THE BENGUELA CURRENT REGION,
Sea Fisheries Research Inst., Cape Town (South Africa).
G. de Villiers.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 1005-1039, 19 fig, 4 tab, 42 ref.

Descriptors: *Benguela current, *Ecosystems, Fish populations, Species diversity, Upwelling, Coastal waters.

The most important exploited and potentially exploitable stocks of the Benguela current region and recent trends in nominal catches and stock indicators are described. Distinct features such as major changes in e.g. the species structure or age structure of certain resources are noted and possible

interchange with resources from neighboring upwelling areas to the south is highlighted. Attention is drawn to selected research needs. (See also W88-04709) (Author's abstract)
W88-04718

OBSERVATIONS ON SPATIAL DISTRIBUTION OF HORSE MACKEREL IN ICSEAF DIVISION 1.3 (OBSERVACIONES SOBRE LA DISTRIBUCION ESPACIAL DEL JUREL EN LA DIVISION 1.3 DE ICSEAF),
Institute of Marine Fisheries, Swinojscie (Poland).
A. Wysokinski.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 1053-1062, 1 fig, 4 tab, 9 ref.

Descriptors: *Horse mackerel, *Fish populations, *Ecological distribution, Population density, Zooplankton, Fish food, Upwelling, Mackerel, Africa.

Widening of the horse mackerel (Trachurus trachurus capensis) population in the open sea direction was observed during the first quarters of 1982 and 1983 in the region of ICSEAF division 1.3. Unlike the first quarter of 1981, the presence of horse mackerel in dense concentrations was observed in 1982 and 1983 not only in the waters over the continental shelf, but over the slope and the deepest waters of the continental edge (up to a depth of 3500 m) as well. The schools of fish live within the water layer located between 20 and 300 m under the sea surface. An attempt to explain this phenomenon was made, by comparing it with the zooplankton distribution and abundance. and with zooplankton contents of horse mackerel stomachs. The above phenomenon also was examined in relation to the Kolesnikov, Mratov and Overko's hypothesis dealing with the influence of the upwelling on the latitudinal migrations of fishes in the Northwest Africa region. (See also W88-04709) (Author's abstract)
W88-04719

SOLE FISHERY OFF THE ORANGE RIVER, SOUTHERN AFRICA,
Sea Fisheries Research Inst., Cape Town (South Africa).
A. I. L. Payne.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 1063-1079, 7 fig, 1 tab, 16 ref.

Descriptors: *Sole, *Fisheries, *Orange River, *Africa, Population density, Fish populations, Biomass, Commercial fishing, Fish migration, Exploitation.

The inshore resource of sole in waters off southern Namibia and northern South Africa once yielded commercially viable catches. Since the late sixties, the stocks of sole have virtually collapsed and, although little or no commercial activity has taken place since, there has been no recovery. Annual biomass determination research cruises took place from 1978 to 1981. Initially the signs of an apparent recovery were there, but the improvement has not been observed in the commercial stock. Over exploitation, possibly combined with migration offshore, is advanced as an explanation for the decline of the Orange River fishery. (See also W88-04709) (Author's abstract)
W88-04720

UPWELLING ZONES OF THE ATLANTICO-IBERO-AFRICAN REGION: THE LEGAL FRAMEWORK AS A FACTOR IN OCEAN RESOURCES MANAGEMENT,
F. Muslim.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela)(Simposio Internacional Sobre las Areas de Afloramiento mas Importantes del Oeste Africano (Cabo Blanco y Benguela)), Volume 2, 1985. p 1099-1114, 13 ref.

Descriptors: *Upwelling, *Africa, *Resources management, Marine resources, Ocean circulation, International Oceanographic Commission, Institutions, Iberian Peninsula.

The state of living resources in upwelling areas, and the potential which they offer for national and regional development in the context of present constraints were studied in the region embracing the countries of the African continent and those of the Iberian peninsula. While the Intergovernmental Oceanographic Commission (the I.O.C.) recognizes eight geographical marine regions, which divide the countries considered in this paper into two distinct marine regions, the organization recognizes that a functional classification would bring the countries under consideration under one functional region. The organization makes the point that functional marine regions may be recognized where there is an identifiable management aspect such as upwelling which occurs in such a way as to make the area of occurrence 'distinguishable from other maritime areas.' The conclusion is inevitable that the nature of the challenge to be addressed is not confined to an improvement of the legal framework. Such a framework must be improved so as to accomodate and facilitate management and utilization systems at both national and regional levels. (See also W88-04709) (Author's abstract)
W88-04721

DISTRIBUTION OF SILVER, MERCURY, LEAD, COPPER, AND CADMIUM IN CENTRAL PUGET SOUND SEDIMENTS,
Connecticut Univ., Groton. Marine Sciences Inst.
For primary bibliographic entry see Field 5B.
W88-04878

EVALUATION OF DEVIATION FROM THE LOGNORMAL DISTRIBUTION AMONG SPECIES AS A POLLUTION INDICATOR IN MARINE BENTHIC COMMUNITIES,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 5A.
W88-04893

WETLANDS OF THE CHESAPEAKE.
Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. 389 p. Edited by Hazel A. Groman, Timothy R. Henderson, Erik J. Meyers, David M. Burke, and Jon A. Kusler.

Descriptors: *Wetlands, *Environmental protection, *Chesapeake Bay, *Conferences, *Water quality control, Information exchange, Water quality, Marshes, Toxicity, Water pollution effects, Agriculture, Water pollution control, Legal aspects, Regulations, Economic aspects, Education.

This April 1985 conference originated from informal discussions among staff members - attorneys, wetland managers, and scientists - of the Association of State Wetland Managers, the Environmental Law Institute and Maryland Department of Natural Resources at the historic December 1983 signing of the Chesapeake Bay Agreement by the Governors of Maryland and Virginia, Lieutenant Governor of Pennsylvania, Mayor of the District of Columbia, and Administrator of the US EPA. Seventy-five experts - scientists, government officials, wetland managers, educators, citizen volunteers, lawyers and others - addressed a capacity audience of more than 250 conferees. Chapters present the original papers of Conference speakers/authors on points of science, management, and future directions and needs. Sections cover: (1) water quality functions of the Chesapeake Wetlands; (2) habitat Functions; (3) flood loss reduction and hydrological values; (4) toxics; (5) urbanization and watercourse modifications; (6) protection strategies (state and federal permitting); and (7) tax incentives and disincentives. (See W88-04935 thru W88-04979) (Lantz-PTT)
W88-04934

OVERVIEW OF POLITICAL, SCIENCE AND MANAGEMENT ISSUES IN THE CHESAPEAKE BAY REGION,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 6E.
W88-04935

WETLANDS OF THE CHESAPEAKE BAY WATERSHED: AN OVERVIEW,
Fish and Wildlife Service, Newton Corner, MA.
R. W. Tiner.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 16-24, 1 fig, 2 tab, 5 ref.

Descriptors: *Chesapeake Bay, *Wetlands, *Watersheds, Estuaries, Databases, Tide lands, Data collections, Forests, Delaware, Maryland, Maps, Information systems.

The predominant wetland groups in the Chesapeake Bay watershed are estuarine wetlands and palustrine wetlands. The five major estuarine wetland types are aquatic beds, tidal flats, emergent wetlands, scrub-shrub wetlands, and forested wetlands. Palustrine wetlands represent both tidal and nontidal emergent wetlands, scrub-shrub wetlands, and forested wetlands, with nontidal forested wetlands the predominant wetland type throughout the Bay drainage basin. Preliminary data from the National Wetlands Inventory's study of recent wetland changes within the watershed reveal a 5% loss of estuarine wetlands, primarily due to urban development; an 8% loss of vegetated palustrine wetlands, caused by agricultural and forestry activities; and a 200% gain in nonvegetated palustrine wetlands, resulting from farm pond construction. Recently, the National Wetlands Inventory (NWI) has cooperated with two states - Delaware and Maryland - to create a digital wetland database. Delaware's database was completed in 1984. All NWI maps were digitized, acreage summaries of wetlands and deepwater habitats for each county prepared, and color-coded county wetland maps produced. The result of this effort is a recently published report documenting the findings of the wetlands inventory for Delaware. The NWI is presently developing a similar database for Maryland. These statewide wetland databases will allow users to: (1) determine the actual extent of wetlands in the state, counties, watersheds, and other designated areas; (2) identify the relative abundance and scarcity of different wetland types; (3) produce color-coded wetland maps at varying scales for specific areas; (4) quickly review site characteristics for facility planning; (5) better analyze the cumulative impacts of wetland development through comparison with historical data and updating future changes; (6) maintain a current wetlands inventory through periodic updating of the database and produce revised maps and acreage summaries; and (7) integrate wetland information with other digital data (e.g., soils) to facilitate natural resource planning. The wetland database can serve as the wetland dataset for existing geographic information systems (GIS) or form the foundation for creating a statewide GIS, where on does not exist. (See also W88-04934) (Lantz-PTT)
W88-04936

CHESAPEAKE BAY FRESHWATER WETLANDS: STATUS AND RESEARCH NEEDS,
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Wetlands Ecology.
For primary bibliographic entry see Field 2H.
W88-04937

EPA AND THE CHESAPEAKE BAY,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W88-04938

SEDIMENTARY PROCESSES AND SEA LEVEL RISE IN TIDAL MARSH SYSTEMS OF CHESAPEAKE BAY,
Maryland Univ., Cambridge. Horn Point Environ-

mental Labs.
J. C. Stevenson, L. G. Ward, M. S. Kearney, and T. E. Jordan.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 37-62, 2 fig, 4 tab, 48 ref.

Descriptors: *Sedimentation, *Sea level, *Tidal marshes, *Chesapeake Bay, Erosion, Marshes, Salt marshes, Estuaries, Sediment load, Wetlands, Turbidity, Suspended sediments, Sediment erosion.

Recent sediment flux and accretion studies have raised some questions about the prevailing view that all wetlands retain sediment. Buffering capacities of these systems depend on such factors as the kind of wetlands, the rate of sea level rise, and the nature of the sediment inputs. In the Chesapeake there are four categories of tidal marsh systems: (1) Coastal High Salinity Marshes; (2) Submerged Upland Marshes; (3) Estuarine Marshes; and (4) Tidal Freshwater Marshes. Rather than accumulating sediments which would allow them to keep pace with rising sea levels, some of the submerged upland marsh systems are rapidly eroding. However, 2-11% of the total sediment input may be trapped by the estuarine and tidal fresh marshes. If sea levels rise as predicted, there will probably be a major shift in the locations of Chesapeake wetlands. Change in marsh abundance will depend both on availability of sediment sources and on the rate of sea level rise. Present attempts by government agencies to limit turbidity in the Bay by reducing sediment inputs must be carefully reviewed for adverse effects they may have on Chesapeake wetlands. (See also W88-04934) (Lantz-PTT)
W88-04939

ROLE OF NON-TIDAL AND TIDAL FRESHWATER MARSHES IN REDUCING NUTRIENT INPUTS IN CHESAPEAKE BAY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W88-04941

SUBMERGED AQUATIC VEGETATION IN THE CHESAPEAKE BAY: VALUE, TRENDS AND MANAGEMENT,
Virginia Inst. of Marine Science, Gloucester Point.
R. J. Orth.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 84-95, 3 fig, 18 ref.

Descriptors: *Aquatic plants, *Submerged plants, *Chesapeake Bay, *Water quality management, Species diversity, Productivity, Nutrients, Turbidity, Dredging, Sediment control, Ecological distribution, Mitigation.

Although Submerged Aquatic Vegetation (SAV) systems in the Chesapeake Bay have a history of distinct oscillations, the recent decline of SAV has affected all native species in all sections of the Bay and is a local phenomenon. Evidence suggests that the major factors responsible for this decline are nutrient enrichment and increased turbidity, and that the adverse impacts on water quality and secondary production may be considerable. If SAV is to be part of the Bay's future, efforts must be concentrated in the short-term on dredge and fill operations, and in the long-term on efforts to control sediment and nutrient inputs. Managers should view transplanting programs with caution, and give priority consideration to conservation of existing beds (as opposed to mitigation plans to offset potential SAV losses). (See also W88-04934) (Lantz-PTT)
W88-04942

WETLAND HABITAT VALUES TO UPLAND WILDLIFE,
Fish and Wildlife Service, Annapolis, MD.
For primary bibliographic entry see Field 2H.
W88-04943

VALUES OF WETLANDS TO ENDANGERED SPECIES WITHIN THE CHESAPEAKE BAY WATERSHED: MARYLAND AND VIRGINIA COASTAL PLAIN,
Mare Nostrum Foundation, Washington, DC.
For primary bibliographic entry see Field 2H.
W88-04944

CONTRIBUTION OF WETLANDS TO ESTUARINE PRODUCTION AND FISHERIES; AN OVERVIEW WITH EMPHASIS ON CHESAPEAKE BAY,
National Marine Fisheries Service, Oxford, MD. Oxford Lab.
For primary bibliographic entry see Field 2H.
W88-04945

VALUES AND FUNCTION OF CHESAPEAKE WETLANDS FOR WATERFOWL,
For primary bibliographic entry see Field 2H.
W88-04946

TIDAL CHANNEL MAINTENANCE: A HYDROLOGICAL FUNCTION OF SALT WATER WETLANDS,
Lehigh Univ., Bethlehem, PA. Fritz Engineering Lab.
R. N. Weisman.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 155-163, 4 fig, 7 ref. NOAA Project No. R/S-6.

Descriptors: *Channel morphology, *Chemical erosion, *Tidal channels, *Salt marshes, *Wetlands, *Tidal hydraulics, Tidal currents, Marshes, Hydrologic models, Geomorphology, Dikes, Sedimentation, Dredging, Channel flow, Channel improvement, Flow profiles, New Jersey.

Research on circulation patterns in New Jersey's Great Sound demonstrates that the water storage and release capabilities of marshes contribute to the magnitude of spring tide ebb flows and, thus, the maintenance of tidal channels. Hydrodynamic modeling of the Great Sound area, stream channel geomorphology, and tidal channel configuration, were all assessed and illustrated that the spring tidal prism would be reduced if these marshes were filled or diked, leading to sedimentation and necessitating dredging of previously-navigable tidal channels. Additional research is needed to correlate channel geometry - width and depth - with peak ebb flow during spring tide and to assess the degree of correlation. (See also W88-04934) (Lantz-PTT)
W88-04948

ROLE OF TIDAL WETLANDS IN THE RETENTION OF HEAVY METALS,
Rider Coll., Lawrenceville, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W88-04949

PRESERVATION OF THE CALIFORNIA COAST: TWENTY YEARS OF LEARNING,
California State Coastal Conservancy, Oakland, CA.
For primary bibliographic entry see Field 6E.
W88-04951

CHESAPEAKE BAY FOUNDATION'S LAND ACQUISITION AND WETLANDS PROTECTION,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
For primary bibliographic entry see Field 6E.
W88-04965

COMBINING SCIENCE AND MANAGEMENT: LOOKING AHEAD FOR CHESAPEAKE WETLANDS CONSERVATION. HOW IS THE FEDERAL, STATE, LOCAL PARTNERSHIP WORKING,
Environmental Protection Agency, Philadelphia, PA. Region III.
For primary bibliographic entry see Field 6E.
W88-04976

COARSE GRAINED FACIES OF GLACIOMARINE DEPOSITS NEAR OTTAWA, CANADA,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2C.
W88-05026

NEARSHORE DEPOSITS OF THE CHAMPLAIN SEA, NEAR OTTAWA, CANADA,
Reading Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W88-05027

BENTHIC MACROINVERTEBRATE ASSOCIATIONS IN RELATION TO ENVIRONMENTAL FACTORS IN GEORGIAN BAY,
Department of Fisheries and Oceans, Ottawa (Ontario).
For primary bibliographic entry see Field 2H.
W88-05033

ECOLOGY OF THE DONACIDAE (MOLLUSCA, BIVALVIA) FROM THE BAY OF MALAGA (SE SPAIN) (ECOLOGIA DE LOS DONACIDAE (MOLLUSCA, BIVALVIA) DE LA BAHIA DE MALAGA (SE DE ESPANA)),
Malaga Univ. (Spain). Dept. de Zoologia.
C. Salas.
Investigacion Pesquera IPESAV, Vol. 51, No. 1, p 67-77, March 1987. 6 fig, 27 ref.

Descriptors: *Mollusks, *Population density, *Spain, *Ecosystems, *Bay of Malaga, Bays, Aquatic populations, Donacidae, Macrofauna, Spatial distribution, Sediments, Organic matter, Species diversity, Aquatic environment.

During research conducted on the infralittoral macrofauna from the Bay of Malaga (southern Spain) between 1981 and 1983, five European species of Donacidae were found living sympatrically. The spatial distribution of Donax trunculus L., Donax vittatus (Da Costa), Donax semistriatus Poli, Donax venustus Poli and Capsella variegata (Gmelin), was studied in relation to depth, texture and organic matter content of the sediment. D. trunculus, D. semistriatus and D. vittatus live at shallower (1-2 m) depths than D. venustus (7-8 m), while D. venustus and D. trunculus are the more abundant species. Only one specimen of C. variegata was taken, at a depth of 18 m. The Donacidae of the Bay of Malaga live primarily in fine sand. The five species live in sediment with low organic content (generally less than 0.50%). This appears to be related to the feeding habits of the Donacidae, suspension feeders that normally live in the wash and offshore zones of beaches where there is a lot of phytoplankton and suspended particulate matter. (Wood-PTT)
W88-05040

EVOLUTION OF PHYSICOCHEMICAL AND BIOLOGICAL FACTORS IN A SALTMARSH-FISH POND OF CADIZ (SW SPAIN) AND ITS RELATION WITH SEA WATER STAGNATION/RENOVATION CYCLES (EVOLUCION DE LAS CONDICIONES FISICOQUIMICAS Y BIOLOGICAS DE UN ESTERO Y SU RELACION CON LOS CICLOS DE ESTANCAMIENTO Y RENOVACION DEL AGUA),
Instituto de Ciencias Marinas, Andalucia (Spain).
A. M. Arias, and P. Drake.
Investigacion Pesquera IPESAV, Vol. 51, No. 1, p 79-95, March 1987. 13 fig, 4 tab, 17 ref.

Descriptors: *Salt marshes, *Tidal marshes, *Tidal effects, *Water quality, *Spain, *Fish ponds, Cadiz, Estuaries, Estuarine environment, Water properties, Chemical properties, Biological properties, Water temperature, Salinity, Dissolved oxygen, Phytoplankton, Zooplankton, Invertebrates.

The maintenance of water quality in the saltmarsh-fish ponds of Cadiz depends on tidal flushing. Four representative zones (water entry-gate and exit-gate, submerged channel, and pans) of the San

Agapito fish pond were selected for the study of: (a) water temperature, salinity, and dissolved oxygen, (b) phytoplankton and zooplankton populations, and (c) invertebrate populations from macrophytes and muddy substrates. All varied in relation to weather changes and to the sequence of stagnation and renovation of sea water. (Author's abstract)
W88-05041

PHYTOPLANKTON SIZE CLASSES DISTRIBUTION IN AN UPWELLING AREA (DISTRIBUCION DEL TAMANO DE LAS ESPECIES DEL FITOPLANCTON EN UN AREA DE AFLORAMIENTO),
Instituto Espanol de Oceanographia, La Coruna (Spain). Centro Costero del La Coruna.
M. Varela, and E. Costas.
Investigacion Pesquera IJMDAI, Vol. 51, No. 1, p 97-105, March 1987. 4 fig, 3 tab, 13 ref.

Descriptors: *Upwelling, *Phytoplankton, *Population density, *Continental shelf, Populations, Spain, Biomass, Distribution patterns, Size distribution, Nutrients, Trophic level, Ocean circulation.

Phytoplankton size classes were studied in several stations of the Galacian continental shelf during BREOGAN-684 and BREOGAN-984 cruises in June and September 1984. Large phytoplankton dominated when phytoplankton biomass was high, while small sizes were predominant when biomass was low. Size distribution is a consequence of the nutrient regime. However, phytoplankton biomass resulting from the integration of cell density and individual size depends on size structure. The possible influence of size distribution on the transference of phytoplankton biomass to higher trophic levels is discussed. (Author's abstract)
W88-05042

REPRESENTIVITY OF ORGANIC MATTER VALUES OBTAINED FROM THE STUDY OF COASTAL SEDIMENTS (REPRESENTATIVIDAD DE LOS VALORES DE MATERIA ORGANICA OBTENIDOS EN EL ESTUDIO DE SEDIMENTOS COSTEROS),
Instituto de Ciencias Marinas, Andalucia (Spain).
For primary bibliographic entry see Field 2J.
W88-05043

RECURRENT GROUPS OF ZOOPLANKTON IN THE BAY OF FUNDY AND SOUTHWEST NOVA SCOTIA REGIONS, CANADA,
Guelph Univ. (Ontario). Dept. of Zoology.
S. Corey, and W. R. Milne.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 10, p 2400-2405, October 1987. 10 fig, 1 tab, 33 ref.

Descriptors: *Zooplankton, *Species diversity, *Population density, *Populations, *Bay of Fundy, *Bays, *Nova Scotia, *Aquatic populations, Canada, Plankton, Species composition, Seasonal variation, Comparison studies, Aquatic environment.

Recurrent group analysis of the Bay of Fundy and southwest Nova Scotia regions on 40 species of zooplankton were compared on a seasonal and annual basis. One major recurrent group occurred per region. Six and five core species occurred in the Bay of Fundy and southwest Nova Scotian waters, respectively. Of these core species, Sagitta elegans, Calanus finmarchicus, and Metridia lucens were common to both areas. The interconnection of the Bay of Fundy and southwest Nova Scotia zooplankton communities is relatively strong (75% of core species for either area occurred in the other area in three of the four surveys). All core species were endemic and boreal. (Author's abstract)
W88-05050

TOTAL CARBOHYDRATE: ORGANIC CARBON RATIO AS AN INDICATOR OF SEWAGE-DERIVED ORGANIC MATTER IN BURBO BIGHT SEDIMENTS, LIVERPOOL BAY, UK,
Lancaster Univ. (England). Lancashire and Western Sea Fisheries Joint Committee.
For primary bibliographic entry see Field 5A.
W88-05070

VOLUMETRIC ESTIMATES OF PHYTOPLANKTON PRODUCTION IN NEWLY UPWELLED WATERS OF THE SOUTHERN BENGUELA CURRENT,
Sea Fisheries Research Inst., Cape Town (South Africa).
E. T. Olivieri, and L. Hutchings.
Limnology and Oceanography LIOCAH, Vol. 32, No. 5, p 1099-1111, September 1987. 6 fig, 2 tab, 36 ref.

Descriptors: *Upwelling, *Primary production, *Phytoplankton, Light, Nitrates, Growth, Winds, Nutrients, Algae, Flagellates, Mixing, Benguela current, Water currents, Ocean circulation.

Production, in terms of volume of particulate matters, was studied in four developing phytoplankton communities in newly upwelled waters of the southern Benguela Current. Growth (max doublings/day approx 2.9, max C production approx 21 g/sq m/day) of phytoplankton upwelled from source water was rapid, with little evidence of a lag phase. The growth pattern differed for each community encountered and was related to the rate of mixing of the water column and the nutrient and light regimes. Production rates were highest in newly upwelled waters and lowest under limiting light and during periods of nitrate depletion in the upper mixed layer. Changes in growth rates also were attributed to short-term wind variation that caused water bodies to mix and change the nutrient regimes. Growth occurred over a wide size range of particles, mostly in the range 20-80 microm equivalent spherical diameters (ED), corresponding to chains of diatoms, but occasionally also in the range of 6-14 microm ESD, suggesting some growth of small-celled algae and microflagellates. A diel variation was observed, with volume increases during the day greatly exceeding those at night except under extreme limiting conditions, when there was some growth in the dark. (Author's abstract)
W88-05093

NITROGEN UPTAKE AND PHYTOPLANKTON GROWTH IN COASTAL UPWELLING REGIONS,
Oregon State Univ., Corvallis. Coll. of Oceanography.
S. A. Kokkinakis and, and P. A. Wheeler.
Limnology and Oceanography LIOCAH, Vol. 32, No. 5, p 1112-1123, September 1987. 7 fig, 3 tab, 28 ref.

Descriptors: *Upwelling, *Primary production, *Phytoplankton, Nitrates, Growth, Nutrients, Chlorophyll a, Oregon, Washington, Benguela current, Water currents, Ocean circulation.

Uptake of nitrogenous nutrients by microplankton off the Washington and Oregon coasts was measured during the 1985 upwelling period. Nitrogen uptake rates in low-NO3(-) waters (less than 5 microM) were 0.020-0.258 micromol N/liter/hr and were primarily supported by regenerated N (71% of total uptake). Nitrogen uptake rates in high-NO3(-) waters (at least 20 uM) were 0.281-1.480 umol N/liter/hr and new (nitrate) N supported 83% of total uptake. Phytoplankton N was estimated by assuming a constant Chlorophyl (Chl) a:particulate N (PN) ratio for phytoplankton and was used to calculate phytoplankton-specific uptake rates. Despite differences in nutrient concentrations, PN, and Chl a at the three upwelling sites (Oregon, Benguela, and Peru), NO3(-) uptake normalized to Chl a and estimates of NO3(-)-supported phytoplankton growth rates are remarkably similar. Nitrate uptake supports growth rates on the order of 1-2/day. Estimates of phytoplankton growth from rates of NH4(+) + NO3(-) uptake range from 1.36-4.79/day and are negatively correlated with concentrations of NO3(-) and phytoplankton N. (Author's abstract)
W88-05094

MEASUREMENTS OF GROUNDWATER SEEPAGE FLUX ONTO A CORAL REEF: SPATIAL AND TEMPORAL VARIATIONS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
J. B. Lewis.
Limnology and Oceanography LIOCAH, Vol. 32, No. 5, p 1165-1169, September 1987. 2 fig, 3 tab, 27 ref.

Descriptors: *Reefs, *Seasonal distribution, *Groundwater movement, *Seepage, Nitrogen, Phosphate, Nutrients, Storm seepage, Corals, Barbados, West Indies, Aquifers, Mathematical models, Rainfall, Prediction.

Rates of groundwater discharge onto coral reefs at Barbados, West Indies, were measured with seepage meters and miniature piezometers. Seepage flux varied spatially, was correlated with water depth, and was about twice as high during the wet season as during the dry. Groundwater N concentrations were correlated with salinity, but phosphate concentrations were not. Nitrate content of the discharge was much higher than the phosphate content. Measured fluxes were consistent with groundwater discharge estimates from aquifer models, but a large data set would be required to make accurate predictions of areal groundwater discharge and nutrient loading. (Author's abstract)
W88-05096

VERTICAL TEMPERATURE GRADIENTS IN MUDDY INTERTIDAL SEDIMENTS IN THE FORTH ESTUARY, SCOTLAND,
Stirling Univ. (Scotland). Dept. of Environmental Science.
S. J. Harrison and, and A. P. Phizacklea.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 954-963, July 1987. 8 fig, 2 tab, 12 ref.

Descriptors: *Temperature, *Tidal effects, *Estuaries, *Heat flow, *Mud flats, Solar heating, Sediments, Seasonal distribution, Thermal gradients, Scotland.

Measurements of subsurface temperature and atmospheric variables were made from an instrument tower at Skinflats on the extensive intertidal mudflats of the Forth estuary. There was a marked seasonal change in the direction and magnitude of gradients. Under strong solar heating during the summer, temperature gradients greater than 100 C/m were recorded. Gradients developed at low water were related to antecedent net radiant energy influx at the mud surface and latent heat flux into the atmospheric boundary layer. The relationship between the change in gradient during an incoming tide and the time of high water showed a well-defined association. The net effect of tidal flooding during both summer and winter is to reduce the steepness of the vertical thermal gradients within the sediment. (Rochester-PTT)
W88-05105

STUDY OF THE EXTRACTION CONDITIONS OF SEDIMENTARY HUMIC ACIDS TO ESTIMATE THEIR TRUE IN SITU SULFUR CONTENT,
British Columbia Univ., Vancouver. Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W88-05106

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

EVALUATION OF THE FEASIBILITY OF A MULTI-PURPOSE SOLAR ROOF STILL IN THE VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
M. J. Canoy, and D. Bullock.
Available from the National Technical Information

Service, Springfield, VA. 22161. Technical Report No. 18, September 1983. 42 p, 8 fig, 5 tab, 17 ref. Contract No. 14-31-0001-5053.

Descriptors: *Solar distillation, *Virgin Islands, *Water supply development, Distillation, Economic aspects.

One approach to the chronic water problems of the Virgin Islands would be widespread use of small solar stills to augment private water supplies. A study was done to: (A) identify critical resource and design factors; (B) estimate the local potential for solar distillation; (C) test the efficiencies of several designs; and (D) determine the production and economic potential of small locally built stills. The design parameters examined were: Deep vs. Shallow Basins, Glass vs. Plastic Covers, 'Roof' vs. Flat Collectors, and rooftop placement. Results of the study shows that the solar energy in the Virgin Islands is not only at a high level but that the level is constant. In the stable Virgin Islands environment, the most simple flat plate, uninsulated collector is nearly as efficient as a complex expensive one. The lowest production was about 0.6 gal/sq ft/day; the highest 0.96 gal/sq ft/day. The average was about 0.8 gal/sq ft/day. Using this figure and 2 cents/gallon purchased water, a 20 sq ft still would supply 20% of a family's needs and have a payback period of less than one year. (Author's abstract)
W88-04706

TUBULAR MEMBRANE SEPARATION PROCESS AND APPARATUS THEREFOR,
Hitachi Ltd., Tokyo (Japan).
T. Takahagi, K. Ebara, and S. Takahashi.
U. S. Patent No. 4,255,255; March 10, 1981. 9 p, 5 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1004, No 2, p 691-692, March 10, 1981.

Descriptors: *Patents, *Reverse osmosis, *Water treatment, *Desalination, *Wastewater treatment, *Membrane processes, Industrial wastes, Separation techniques, Chemical treatment, Proteins, Enzymes, Acids, Ultrafiltration.

Reverse osmosis tubular membrane separation is used for wastewater treatment, desalination, concentration, separation, and purification of proteins, enzymes, and nucleic acids. Modules of tubular semipermeable membranes are surrounded by liquid-permeable supports. The modules are arranged in multiple stages. A solution tank feeds a solution to the modules. The modules are adapted to receive the solution together with elastic tube-cleaning elements. A conduit connected to the solution tank conducts the solution from the tank to the recovery system. A second conduit supplies the elastic elements from the recovery system to the upstream side of the modules. In cleaning the semipermeable membrane surfaces of the tubular modules, the elements are forced, together with the solution being treated under pressure as a carrier solution, through the tubes. (Cremmins-AEPCO)
W88-04786

PROCESS FOR PURIFYING LIQUIDS AND A DEVICE FOR CARRYING OUT THE PROCESS,
S. E. L. Rasmark.
U. S. Patent No. 4,243,526; January 6, 1981, 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1002, No 1, p 262, January 6, 1981.

Descriptors: *Distillation, *Patents, *Desalination, *Water treatment, *Heat treatment, *Seawater, Salts, Heating, Condensation, Heated water, Spraying, Water cooling.

Seawater for desalination is fed into a sealed container or chamber and guided toward a heated stream of air in the chamber. The seawater is sprayed to engage the stream of air during the heating cycle. The resulting damp air is condensed and the condensate is discharged from the chamber through one line. The remaining water is discharged through a second line. (Cremmins-AEPCO)
W88-04789

PROCESS AND APPARATUS FOR ION EXCHANGE BY USE OF THERMALLY REGENERABLE RESIN,
Rohm and Haas Co., Philadelphia, PA.
K. Kosaka, T. Iwatsuka, I. Shindo, and A. Hotogi.
U. S. Patent No. 4,293,423; October 6, 1981, 8 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1011, No 1, p 255, October 6, 1981.

Descriptors: *Patents, *Desalination, *Water treatment, *Ion exchange, *Resins, Seawater, Industrial water, Domestic water, Municipal water, Heat treatment.

Industrial, municipal, household, and seawater is desalinated using continuous or semi-continuous ion exchange and a thermally regenerable and heterogeneous resin. A column packed with the resin is placed in a single bed having loading, heat displacement, and regeneration zones. An aqueous feed liquid containing an excessively high concentration of ions flows upwardly through the loading zone to reduce the concentration of ions; the resultant treatment liquid is withdrawn as product liquid from near the top of the loading zone. The remainder of the product liquid flows upward into the heat displacement zone. An aqueous liquid regenerant flows at a higher temperature than that of the feed liquid through the resin in the regeneration zone to regenerate the resin. The flow of aqueous liquid in the heat displacement zone is controlled so as to maintain a temperature differential between the loading and regeneration zones. The loaded resin is transferred from the loading zone to the regeneration zone and the regenerated resin is displaced downward in the column to replace the transferred resin. (Cremmins-AEPCO)
W88-04812

3B. Water Yield Improvement

URBAN STORMWATER HARVESTING: APPLICATIONS AND HYDRAULIC DESIGN,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Journal of Environmental Management JEVMAN, Vol. 25, No. 1, p 71-79, July 1987. 1 fig, 13 ref.

Descriptors: *Water management, *Water harvesting, *Storm water, *Water spreading, *Water conservation, *Urban runoff, Hydraulic design, Runoff, Water supply, Ponds, Storage reservoirs, Irrigation, Water storage, Water quality, Water treatment, Storage.

Potential applications of urban storm water harvesting may be classified as (1) water spreading or runoff irrigation or (2) water which has been formally stored or treated. Water spreading involves a shallow basin planted with relatively water-loving plants, especially those which can tolerate irregular, intermittent irrigation. Water that does not infiltrate within a short period may stand in the basin or run into a pond which can serve many purposes, including esthetic attractiveness, recreation, flood control, sediment control, or storage for irrigation. Although costs of water spreading are low, the system is inefficient, with great variability with respect to time and volume of water delivery and water quality. With additional expense, harvested water can be stored in an open pond or covered tank for use in applications which do not require further treatment. With still further expense, water can be stored and treated for use in cleaning, cooling, or drinking. Water harvested from rooftops usually requires only filtration and chlorination. Hydraulic design of water harvesting systems must consider the volume of storm water flows and the applications. Methods are given for estimating water demands (pond or irrigation), efficiency of the catchment supplying the water, storage requirements, and storm water volume. For a site-specific application formulas are presented to plan a system combining water harvesting, imported water, and precipitation. (Cassar-PTT)
W88-05066

3C. Use Of Water Of Impaired Quality

FUTURE USE OF SLUDGE ENTRENCHMENT SITES,
Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab.
For primary bibliographic entry see Field 5E.
W88-04525

CROP-WATER PRODUCTION FUNCTIONS FOR SWEET CORN AND COTTON IRRIGATED WITH SALINE WATERS,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
D. Russo, and D. Bakker.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1554-1562, November-December 1987. 7 fig, 5 tab, 23 ref.

Descriptors: *Saline water, *Cotton, *Corn, *Impaired water use, *Irrigation, *Crop-water production, Crop yield, Water quality, Irrigation water, Soil salinity, Trickle irrigation, Evaporation.

The effect of irrigation water quality (salinity) and quantity on the yields of sweet corn (Zea mays cv. Jubilee) and cotton (Gossypium hirsutum L. cv. Acala SJ-2) was studied in a sandy loam (Typic Torrifluvent) soil. For each of the irrigation water salinities of C sub o = 1.8, 3.6 and 6.7 dS/m (for corn) and C sub o = 3.6, 6.7, and 10.5 dS/m (for cotton), 10 amounts of irrigation water (Q) ranging from 0.15 to 2.7 times the class A pan evaporation (E sub o) were applied via trickle irrigation. Root zone soil-water matric potential, water content, and salinity were monitored, and corn and cotton yield components were measured. Time-averaged root zone soil water content (theta) and soil salinity (EC), as well as crop yield components (Y) were affected by both Q and C sub o. Results of the analyses of the crop-water production functions suggest that increasing the amount of irrigation water may compensate only in part for the adverse effects of the salinity of the irrigation water. For corn, using irrigation water of C sub o = 3.6 and 6.7 dS/m, maximum ear yields were reduced by 8 and 27%, respectively, relative to the maximum ear yield obtained using water of 1.8 dS/m. For cotton, using irrigation water of C sub o = 6.7 and 10.5 dS/m, maximum seed cotton yields were reduced by 6.5 and 30%, respectively, relative to the maximum seed cotton yield obtained using water of 3.6 dS/m.. Analysis of the Y(theta,EC) relationship for each of the corn and the cotton yield components suggested that, due to the mutual effect of theta and, in general, should be described by a nonlinear concave expression. (Author's abstract)
W88-04639

METHOD FOR OIL RECOVERY FROM RESERVOIR ROCK FORMATIONS,
D. Balzer.
U.S. Patent No. 4,582,138; April 15, 1986, 9 p, 4 ref. Official Gazette of the United States Patent Office, Vol 1065, No 3, p 1163, April 15, 1986.

Descriptors: *Patents, *Oil recovery, *Oil reservoirs, *Water bleeding, *Emulsifiers, Tensides, Detergents, Rocks, Salinity, Tertiary oil recovery.

At least two tenside-containing liquids are injected to extract reservoir oil from rock formations of medium or high salinity. The tenside is a carboxymethylated oxethylate and at least one of the liquids is an emulsion comprising an oil phase, an aqueous phase, and a carboxymethylated oxethylate tenside as the emulsifier. The emulsifier is selected so that the phase inversion temperature of the system lies within 0 to 10 C above the reservoir temperature. At least one of the liquids is a solution or dispersion of a carboxymethylated oxethylate tenside in flooding water. The tenside is also selected so that the phase inversion temperature of the system lies 0 to 10 C above the reservoir temperature. (Cremmins-AEPCO)
W88-04727

3E. Conservation In Industry

COUNTY-LEVEL PROJECTIONS FOR INDUSTRIAL WATER DEMAND IN MISSISSIPPI,
University of Southern Mississippi, Hattiesburg. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W88-04753

3F. Conservation In Agriculture

ENERGY AND WATER BALANCE OF A SPARSE CROP: SIMULATED AND MEASURED SOIL AND CROP EVAPORATION,
Texas Agricultural Experiment Station, Lubbock.
For primary bibliographic entry see Field 2G.
W88-04496

EFFECTS OF FURROW DIKES ON WATER CONSERVATION AND DRYLAND CROP YIELDS,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
O. R. Jones, and R. N. Clark.
Soil Science Society of America Journal SSSJO4, Vol. 51, No. 5, p 1307-1314, September-October 1987. 5 fig, 5 tab, 23 ref.

Descriptors: *Water conservation, *Furrow irrigation, *Dikes, *Crop yields, Sorghum, Sunflowers, Runoff, Surface runoff.

A study was conducted to (1) examine the potential of furrow dikes as a conservation practice to retain runoff and increase crop yields, and (2) examine the effects of furrow diking on sorghum and sunflower production. Analyses of 28 yr of runoff records showed that furrow diking has the potential to retain 25 to 30 mm of runoff annually. The maximum annual runoff retention by diking observed during the 14 crop years of research (three separate experiments conducted between 1980 and 1985) was 111 mm. The maximum increase in sorghum yield measured as a result of diking was 2.46 mg/ha. Conditions responsible for maximum yield responses of sorghum to diking were: (1) annual cropping; (2) large rainfall/runoff events occurring prior to or early in the growing season; and (3) limited growing season precipitation. Diking increased annual cropped sorghum yields on graded and contour furrow treatments by 49 and 14%, respectively, whereas water use efficiencies were increased by 25 and 16%. Yields and water use efficiencies from diked treatments on graded and contour furrows were as great as yields and water use efficiencies from a leveled minibench treatment, indicating that from a crop production standpoint, furrow diking was as effective as land leveling in retaining runoff and increasing crop yields. Sunflower yields were increased significantly by diking during 1 yr out of 3 when sunflower was grown after 76 weeks of fallow, whereas sorghum yields were not affected by diking after fallow. Decreasing row spacing from 1.0 to 0.75 m resulted in a significant increase in the 3-yr avg. yield of sorghum and sunflower of 1.0 and 0.14 mg/ha, respectively, when grown after fallow, indicating that considerable opportunity for improving summer crop production may exist simply by changing to a narrow row spacing. A regression equation relating runoff from graded furrows to runoff from contour flat-tilled graded terraces showed increased runoff from graded furrows, particularly from small storms. (Lantz-PTT)
W88-04502

IRRIGATION WATER CHARGE IN CHINA,
University of Agricultural Engineering, Beijing (China). Dept. of Irrigation and Drainage.
For primary bibliographic entry see Field 6C.
W88-04522

ARE LARGE SCHEMES WORTH THE COST,
For primary bibliographic entry see Field 6C.
W88-04523

USE OF EVAPORIMETERS FOR ESTIMATING MAXIMUM TOTAL EVAPORATION,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Agrometeorology.
For primary bibliographic entry see Field 7B.
W88-04568

RIGHT TO USE VERSUS THE RIGHT TO SELL: SPILLOVER EFFECTS AND CONSTRAINTS ON THE WATER RIGHTS OF IRRIGATION ORGANIZATION MEMBERS,
National Center for Atmospheric Research, Boulder, CO. Environmental and Societal Impacts Group.
For primary bibliographic entry see Field 6C.
W88-04597

WATER-HYACINTH (EICHHORNIA CRASSIPES) IN RUMINANT NUTRITION,
Sao Paulo Univ., Piracicaba (Brazil). Secao de Ciencias Animais.
A. L. Abdalla, E. J. Ambrosano, D. M. S. Vitti, and J. C. Silva F.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 109-112, 1987. 2 tab, 11 ref.

Descriptors: *Water hyacinth, *Aquatic plants, *Ruminants, *Waste disposal, Nutrition, Sheep, Recycling, Chemical analysis.

In a pilot experiment, ten sheep were used to study the possibility of using water hyacinth as ruminant feed. The mean live weight of the animals was 30.5 kg; they were kept in individual pens. Water hyacinths were fed 4.0 kg/d once a day plus 300 g of a concentrate mixture. The mean intake was 3.6 kg of fresh water hyacinth per animal and the chemical analyses of dried material showed respectively, 10.00%, 15.96%, 16.28%, 2.65% 47.29% and 17.84% for dry matter, crude protein, crude fiber, ether extract, non-nitrogen extract, and mineral matter. The dry matter remaining in nylon bags after 48 hours incubation in the rumen of a steer was 55.29%. It was concluded that water hyacinth has potential as a roughage source for ruminants, but further investigation needs to be done on harvesting and storage of fresh material. (Author's abstract)
W88-04624

SHRINKAGE CURVE INDICES TO QUANTIFY CULTIVATION EFFECTS ON SOIL STRUCTURE OF A VERTISOL,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Soils
For primary bibliographic entry see Field 2G.
W88-04643

INTERMITTENT EVAPORATION FROM SOIL COLUMNS AS AFFECTED BY A GEL-FORMING CONDITIONER,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Soil Science.
A. M. Al-Omran, M. A. Mustafa, and A. A. Shalaby.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1593-1599, November-December 1987. 7 fig, 5 tab, 20 ref.

Descriptors: *Evaporation control, *Soil columns, *Soil conditioners, Humic acids, Polysaccharides, Soil aggregates, Irrigation, Soil water, Soil moisture retention, Jalma, Soil structure, Soil properties, Sands, Loam, Clays, Water conservation.

The effect of an organic super gel commercially called Jalma (containing 24% humic acids, and 3.8% polysaccharides) at rates of 0.0, 0.4, 0.8, and 1.6% on aggregation index (AI) and relative swelling index (RSI) of loamy sand, sandy loam, and clay loam soils was studied. Furthermore, the influence of these rates and two irrigation intervals, 7 and 14 d, on intermittent evaporation from surface-treated soil columns were also investigated. Twenty-two or 44-mm of water were applied every 7 or 14 d, respectively. The soil columns were placed in a walk-in controlled growth chamber with potential evaporation of 8.2 mm/d. Addition of 0.4% Jalma significantly increased AI of the three soils by 33 to 38%. Increase of the Jalma rate to 0.8% significantly improved the AI of the fine-textured sample but not the coarse-textured samples. Further increase to 1.6% had no significant effect on the AI of the three samples. The lowest rate of Jalma significantly increased RSI of the three samples. The results also indicated a sharp, significant increase in RSI with increase in Jalma rate to 1.6%. In general, Jalma treatment significantly reduced cumulative evaporation and hence increased the amount of water conserved (AWC) after the first wetting/drying cycle. After four evaporation cycles, on 0.4% treated loamy sand, sandy loam, and clay loam soils, the AWC values were, respectively, 4.3, 3.2, and 1.5 times that of the untreated soils. The AWC values for untreated loamy sand, sandy loam, and clay loam soils irrigated every 14 d were, respectively, 2.6, 1.7, and 1.6 times those irrigated weekly. (Author's abstract)
W88-04646

RESPONSE OF CASSAVA TO WATER STRESS,
Centro Internacional de Agricultura Tropical, Cali (Colombia).
For primary bibliographic entry see Field 2I.
W88-04655

QUANTIFYING SURFACE WATER SUPPLIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 7C.
W88-04669

USDA-SOIL CONSERVATION SERVICE IRRIGATION WATER MANAGEMENT PROGRAM IN MISSISSIPPI,
Soil Conservation Service, Greenwood, MS.
P. B. Rodrigue, and R. K. Harris.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 27-32, 3 fig, 3 tab, 2 ref.

Descriptors: *Irrigation, *Water management, *Mississippi, *Groundwater management, *Soil compaction, Irrigation programs, Agriculture, Irrigation efficiency, Groundwater irrigation.

The Mississippi alluvial aquifer provides groundwater for irrigation in the Mississippi delta. Although this aquifer is not a principal source for potable water, questions of quality and quantity of groundwater remain a concern, primarily due to the enormous economic impact of irrigated agriculture. Recent studies indicate that localized shortages may occur in the central delta region. Just over 1 billion gallons of water per day is pumped from the ground for rice, catfish, cotton, and soybean production. This is two times the daily consumption of the cities of Jackson, Tupelo, and Vicksburg combined. To help Mississippi farmers use their water resources most efficiently, the USDA-Soil Conservation Service initiated an Irrigation Water Management (IWM) program in the summer of 1985. The initial thrust of the irrigation team has been directed toward evaluating the performance of existing center-pivot irrigation systems for water and energy use efficiency and the intake characteristics of the soil under these systems. There are approximately 1000 center pivot systems in the delta. One center pivot system pumping 1200 gpm will pump 1-3/4 million gallons/day, which is the equivalent to the water use of the town of Indianola. The irrigation team is also responsible for updating the Mississippi irrigation guide with information on the intake capability of different soils under different cropping patterns. Briefly explained here are the 1986 test methods, accomplishments, and goals of the IWM team. The work performed indicates that irrigation systems are being designed on values of infiltration that are inaccurate and outdated. A center pivot evaluation increases a farmer's ability to manage his crops. Compaction is undoubtedly a widespread problem. Compaction can limit the amount of rainfall stored by the soil, thereby increasing the demand on groundwater supplies. (See also W88-04665) (Lantz-PTT)
W88-04672

IRRIGATION VALVE APPARATUS,
W. B. Watson.
U.S. Patent No. 4,340,081; July 20, 1982, 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1020, No 3, p 868, July 20, 1982.

Descriptors: *Patents, *Flow control, *Surface irrigation, *Irrigation systems, *Water conveyance, Agriculture, Flow discharge.

A valve apparatus controls the water flow in an agricultural irrigation water line. A valve plate in the water line is secured to a piston movable in a cylinder above the plate and within the flow of water. Control pressure in the cylinder acts on the piston in one direction, while the pressure from the flow of the water in the irrigation line acts directly on the valve plate. Movement of the plate in response to the pressure of a control fluid on one side of the piston and to the pressure of the water supply acting on the valve plate causes the plate to move, thus allowing water from the water line to flow through the valve. (Cremmins-AEPCO)
W88-04735

HEAD CONTROL STAND,
C. E. Schafer, W. P. Schafer, and C. J. Schafer.
U. S. Patent No. 4,621,945; November 11, 1986, 4 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1092, No 2, p 609, November 11, 1986.

Descriptors: *Patents, *Tile drainage, *Irrigation design, *Drainage engineering, *Surface irrigation, Water table, Water metering, Irrigation engineering, Groundwater irrigation, Water level recorders.

A head stand controls water flow within a drainage irrigation tile and the water table level in association with subsurface drainage and irrigation systems. The head control stand contains a riser pipe connected to a section of conventional drain tile by a junction having a valve within the junction and operated in response to changes in the water table level by an actuating unit housed within the riser pipe. The valve includes a seal ring within the junction against which rests a metering plate with a flap resting on its inside surface. An O-ring surface extends around the circumference of the metering plate and engages the seal ring. The flap is held in place by two conventional bolt-nut assemblies, which also hold a handle bracket which threadably receives a handle. The actuating unit includes a float attached to the flap via a flexible cord. The float rides on the surface of the water table within the riser pipe and is adjusted to open the flap as the water table rises above a predetermined level thus allowing water to flow through the metering plate. (Cremmins-AEPCO)
W88-04784

SELF-SUSTAINING LAND IRRIGATING AND HYDROELECTRIC POWER GENERATING SYSTEM,
W. W. Keeling.
U. S. Patent No. 4,341,490; July 27, 1982, 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1020, No 4, p 207, July 27, 1982.

Descriptors: *Patents, *Irrigation designs, *Surface irrigation, *Pumps, *Hydraulic rams, *Hydroelectric power, Hydraulic equipment, Electric power, Water tanks, Irrigation engineering, Irrigation water, Gravity flow.

Hydraulic rams lift water utilizing external power into a series of tanks along an irrigation network to produce a system which may continue indefinitely as long as the initial source of water exists. An elevated storage tank, which receives water from a first hydraulic ram, contains an overflow pipe. An irrigation pipe near the hydraulic ram and elevated tank, an externally powered pump delivering exhaust water from the hydraulic ram to the irrigation pipe, a second downstream hydraulic ram and second elevated storage tank receiving water from the second hydraulic ram and having an overflow pipe, and a second irrigation pipe receiving water by gravity flow discharged by the second hydraulic ram are also components of the irrigation system. Electrical power can also be generated in the system at the initial and secondary water sources. (Cremmins-AEPCO)
W88-04787

IRRIGATION SYSTEM,
J. M. Chance.
U. S. Patent No. 4,464,079; August 7, 1984, 6 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1045, No 1, p 225, August 7, 1984.

Descriptors: *Patents, *Furrow irrigation, *Irrigated water, *Irrigation design, *Irrigation canals, Irrigation engineering, Monitoring, Water metering.

An irrigation system includes primary and secondary canals and an alarm system apparatus for monitoring water flow from the primary to the secondary canal. The system contains enclosed ends so that water flowing into the secondary canal accumulates and eventually overflows from the canal unless a sufficient volume of water is removed. A water control unit diverts the flow of water between the canals. Water is directed from the secondary canal into furrows in a field adjacent to the canal at a volume necessary to prevent the canal from filling and overflowing. The alarm apparatus alerts an individual when water is directed from the primary canal into the secondary canal at a rate faster than the rate at which water is drawn from the secondary canal into furrows adjacent to the canal. (Cremmins-AEPCO)
W88-04788

WEED SCREEN AND TRASH ELIMINATOR,
D. Grebb.
U. S. Patent No. 4,253,952; March 3, 1981, 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1004, No 1, p 256-257, March 3, 1981.

Descriptors: *Patents, *Irrigation canals, *Irrigation ditches, *Nuisance algae, *Screens, Algal control, Detritus, Water conveyance, Cleaning.

A weed screen and trash eliminator for irrigation canals continuously and automatically removes moss, algae, leaves, stems, litter, and weed seeds to prevent damage to pumps and irrigation equipment. The screen and trash eliminator consists of a rigid open frame with longitudinal sides that is adapted to abut a weir or other water delivery structure to a rear end of the frame. A longitudinal stationary screen extends transversely between the sides of the open frame. A moveable endless conveyor is mounted along the sides of the frame. Transverse bristle brushes fixed across the conveyor engage against the upper screen surface. A system on the frame directs incoming water from the weir or other water delivery structure onto the planar upper screen surface. A recessed catch pan is fixed across the frame immediately adjacent to the rear of the screen to receive materials swept from the screen by the brush. (Cremmins-AEPCO)
W88-04814

IRRIGATION AND DRAINAGE APPARATUS,
M. J. Robey, D. E. Bingaman, and A. E. Read.
U. S. Patent No. 4,293,237; October 6, 1981, 8 p, 9 fig. Official Gazette of the United States Patent Office, Vol 1011, No 1, p 194-195, October 6, 1981.

Descriptors: *Patents, *Subsurface irrigation, *Subsurface drainage, *Weirs, *Irrigation design, *Drainage systems, Drainage engineering, Irrigation engineering, Evaporation control, Water distribution, Cleaning, Aeration, Fertilization.

An underground irrigation and drainage system minimizes evaporation losses and provides a precise, controlled and uniform application of water throughout an area through use of weirs arranged in main and lateral lines for the maintenance of desired liquid levels. The apparatus includes at least one main line; cross pieces for coupling lateral lines or laterals to the main line; and sleeves for joining pipes together for on-site assembly, with certain of the sleeves and cross-pieces preferably including weirs. The sides of the weir configuration are slanted to facilitate cleaning. Placement of weirs within main and lateral lines provides for both aerating and fertilizing of the flow throughout the main and lateral lines. (Cremmins-AEPCO)
W88-04815

TRICKLE IRRIGATION,
K. B. Pollock.
U. S. Patent No. 4,317,539; March 2, 1982, 10 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1016, No 1, p 107-108, March 2, 1982.

Descriptors: *Patents, *Trickle irrigation, *Irrigation design, *Irrigation practices, Water conveyance, Pipes, Water mains, Irrigation engineering, Flushing, Polymers.

A trickle irrigation system operates at 10 psi maximum using inexpensive, rigid thin-walled PVC pipe of large diameter; is highly energy efficient; and is capable of delivering a specified quantity of water to each discharge point with a deviation of plus or minus 20%. The system comprises a buried, generally horizontal main line adapted to be connected to a source of water; open top emitters in communication with the main line and extending vertically a predetermined distance above ground with the discharge points of the emitters having substantially the same height above sea level; and an open-top, closed-bottom flush pipe in fluid communication with the emitters. The flush pipe open top is removably capped so that no water may flow through it, when it is in place. (Cremmins-AEPCO)
W88-04816

IRRIGATION MONITORING SYSTEM,
G. A. Hornabrook.
U. S. Patent No. 4,431,338; February 14, 1984, 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1039, No 2, p 669, February 14, 1984.

Descriptors: *Patents, *Surface irrigation, *Irrigation design, *Irrigation water, Irrigation engineering, Water conveyance, Flow control, Flow channels, Moisture content.

An automatically controlled irrigation system contains a main channel running the length of the area to be irrigated and outlets to irrigation bays. The opening and closing of outlets are controlled by signals from a central control. The main channel comprises a supply of water, a separate distribution channel connecting each bay to the main channel, and a flow control system for each distribution channel, which initiates and stops the flow of water to its irrigation bay. A sensing system in each bay senses a predetermined moisture content at a preselected location in each bay. (Cremmins-AEPCO)
W88-04817

IRRIGATION SYSTEM,
K. O. Thornton.
U. S. Patent No. 4,538,377; September 3, 1985, 4 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1058, No 1, p 34, September 3, 1985.

Descriptors: *Patents, *Subsurface irrigation, *Irrigation design, *Pipelines, *Subsurface drainage, *Drainage systems, Subsurface drains, Crop production, Chemical treatment, Herbicides, Water storage.

Field crops growing on the top soil surface are treated using a pipe submerged below the root system of the crops and a drain pipe submerged beneath the treatment pipe. The treatment pipe is connected to water and chemical distribution sources, either of which may be optionally opened, closed or partially opened, or partially closed. The drain pipe is connected to a water storage source for storing field drained water. The field drained water may be transferred to the storage tank for recycling during arid periods. The drainage and irrigation system may be used for the underground application of chemicals and herbicides. (Cremmins-AEPCO)
W88-04822

IRRIGATION MEANS AND METHOD,
H. E. Klein.
U. S. Patent No. 4,330,222; May 18, 1982, 5 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1018, No 3, p 959, May 18, 1982.

Descriptors: *Patents, *Irrigation systems, *Subsurface irrigation, *Water distribution, *Pipes, Particulate matter, Gravel, Irrigation water, Flow discharge, Irrigation design.

An underground irrigation system contains a water distribution pipe and at least one strainer box over the pipe. The strainer box contains gravel or other particulate material and the distribution pipe contains a water emitting aperture within the strainer box for discharging water into the particulate material. The strainer box comprises walls defining a container and strands intercepting at cross-over points to form mesh. (Cremmins-AEPCO)
W88-04828

SUBSURFACE IRRIGATION,
Y. Rosenthal.
U. S. Patent No. 4,402,631; September 6, 1983, 3 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1034, No 1, p 190, September 6, 1983.

Descriptors: *Patents, *Irrigation systems, *Subsurface irrigation, *Conduits, *Water distribution, Nozzles, Pipes, Tubes, Evaporation, Irrigation design.

Subsurface pipes or tubing precisely supply water underground to prevent evaporation by the sun and wind. The irrigation system comprises an elongated flexible tubular conduit having a longitudinal outlet opening band of nozzles. A protective flap extends longitudinally along and is secured to the conduit at one side of the opening band. The flap has a free longitudinal edge opposite to the secured edge and located at the other side of the opening band from the secured longitudinal edge. The conduit is curved in an unrestrained position, and when it is straightened causes the free longitudinal edge of the protective flap to be biased against it. (Cremmins-AEPCO)
W88-04833

SEQUENCING VALVE AND IRRIGATION,
C. C. Rodieck.
U. S. Patent No. 4,497,333; February 5, 1985, 6 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1051, No 1, p 100, February 5, 1985.

Descriptors: *Patents, *Irrigation engineering, *Hydraulic valves, *Flow control, Agricultural engineering, Pressure conduits.

A valve system automatically builds a pressured air cushion when the primary valve outlet closes and hydraulic pressure is applied in orchard irrigation systems. The air cushion is a chamber associated with the primary outlet closure and in direct communication with the valve body interior. When the automatic closure covers the primary outlet and water is diverted through the inverted U, the resulting hydraulic pressure builds a corresponding pressure in the air cushion by compressing the air in it. Even though there may be a tendency for hydraulic pressure loss owing to conditions in the succeeding valve, complete pressure loss is avoided because the compressed air expands to maintain pressure. Upstream primary outlets are then prevented from opening. Each valve of the system is equipped with the same type air cushion to protect both the initial pressure wear inlet and the last in the series of valves having closed primary outlets. (Cremmins-AEPCO)
W88-04836

MULTI-LAYERED CORRUGATED CONDUIT WITH 'BLACK-EYE' LIKE APERTURES,
Hancor, Inc., Findlay, OH.
For primary bibliographic entry see Field 4A.
W88-04837

DRIP IRRIGATION HOSE,
J. W. D. Robbins.
U. S. Patent No. 4,430,020; February 7, 1984, 7 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1039, No 1, p 213, February 7, 1984.

Descriptors: *Patents, *Drip irrigation, *Hoses, *Irrigation engineering, *Conduits, Channels, Flow discharge, Turbulent flow, Trickle irrigation, Flow control.

A drip irrigation hose contains a primary channel or conduit for receiving a supply of liquid and a secondary, regulatory conduit. The latter conduit is characterized by a strip or plate of material between the lapped edges of the primary conduit and having multiple fluid flow paths inscribed in the plate and extending repetitively from the high pressure interior of the primary conduit through paths formed by adjacent segments of the plate and exiting to the surroundings at the low pressure discharge side of the plate. Each flow path in the regulatory secondary conduit is small, zigzags, and serves to reduce the water or liquid pressure from the interior of the primary conduit to the point of discharge of the liquid from the regulatory secondary conduit to the atmosphere. (Cremmins-AEPCO)
W88-04843

PROCEEDINGS OF THE OGALLALA AQUIFER SYMPOSIUM II,
Texas Tech Univ., Lubbock. Water Resources Center.
For primary bibliographic entry see Field 4B.
W88-04894

HIGH PLAINS REGIONAL AQUIFER -- ESTIMATING 1980 GROUND-WATER PUMPAGE FOR IRRIGATION,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 4B.
W88-04896

HIGH PLAINS REGIONAL AQUIFER -- MAPPING IRRIGATED AGRICULTURE USING LANDSAT DATA,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
For primary bibliographic entry see Field 7B.
W88-04897

GENERALIZED METHOD FOR ECONOMICALLY EVALUATING IRRIGATION DECISIONS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
D. L. Martin, J. R. Gilley, D. G. Watts, and R. J. Supalla.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 67-82, 7 fig, 2 tab, 12 ref.

Descriptors: *Groundwater irrigation, *Evapotranspiration, *Economic evaluation, *Groundwater management, *Decision making, Economic feasibility, Crop yield, Simulation analysis, Mathematical models, Project planning, Irrigation efficiency, Profit.

A method for analyzing production functions for optimal irrigation decisions based upon physical parameters was developed. The method employs the relationship of grain yield to evapotranspiration, which has been shown to be more general than yield-irrigation relationships. The physical parameters used in the production function can be determined from field measurements or from simulation methods. In either case, the variation of crop yield, and ultimately of profit from irrigation, can be determined. One advantage of this approach is that irrigation management decisions can be related to prices, costs, and the physical parameters to derive more general conclusions than are possible with empirical production functions. Results are presented to show the optimal irrigation depth as a function of energy cost, grain prices and the physical parameters, when either land or water is limiting. These findings should be helpful to economists in studying irigation economics, and to producers in making management decisions. (See also W88-04894) (Author's abstract)
W88-04899

ECONOMIC EVALUATION OF THE OGALLALA AQUIFER IN OKLAHOMA: WHAT DOES THE FUTURE HOLD,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
H. P. Mapp.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 83-97, 3 fig, 3 tab, 4 ref.

Descriptors: *Groundwater irrigation, *Sensitivity analysis, *Irrigation efficiency, *Economic life, *Ogallala Aquifer, Crop yield, Economic aspects, Prices, Crop production, Groundwater management, Economic evaluation, Oklahoma, Energy, Inflation.

Recent studies have evaluated the economic life of the Ogallala Aquifer in Oklahoma. A baseline analysis evaluated the impact of future changes in crop prices, energy costs, crop yields, and improvements in irrigation technology on the profitability of irrigated crop production in the region. The baseline analysis assumed that agricultural commodity prices would increase more rapidly than the rate of inflation over the period 1977-2020. Crop yields and energy costs were also projected to increase substantially over the period. Results of the baseline analysis indicated that irrigated crop production in northwestern Oklahoma would decrease slightly because of higher energy costs in the early part of the 1980's, and then increase consistently to the year 2020. This result was not expected and several sensitivity analyses were conducted to determine the factors most likely to change the baseline results. In one sensitivity analysis, energy prices were assumed to increase more rapidly than in the baseline analysis. In a second sensitivity analysis, crop yields were assumed to increase more slowly than in the baseline. In a final sensitivity analysis, agricultural commodity prices were assumed to increase at a rate just equal to the rate of inflation. The results of the sensitivity analyses revealed that the levels of agricultural commodity prices were important in determining the economic life of the irrigation water supply. With constant real agriculture commodity prices, irrigated acres declined throughout the period of analysis. By the year 2020, only one third of the acres currently irrigated were still irrigated in the Oklahoma study region. Agricultural commodity prices were more important than energy costs or yield increases in determining the economic viability of the Ogallala area. Water conservation techniques have the potential for reducing the quantity of water used, reducing irrigation pumping costs, and lengthening the economic life of the irrigation water supply. (See also W88-04894) (Author's abstract)
W88-04900

IRRIGATION WATER MANAGEMENT RESEARCH -- SOUTHERN OGALLALA REGION,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
J. T. Musick.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 98-122, 6 fig, 5 tab, 32 ref.

Descriptors: *Ogallala Aquifer, *Irrigation efficiency, *Groundwater irrigation, *Crop production, *Irrigation requirements, Irrigation-return flow, Irrigation practices, Corn, Sorghum, Wheat, Crop yield, Groundwater management, Groundwater storage, Groundwater depletion, Texas, Kansas.

The southern Ogallala Aquifer includes essentially all the areas where water table decline has exceeded 50% of predevelopment storage. Irrigation research within the sourthern Ogallala began at Lubbock, Texas, in 1937; and at Bushland, Texas, and Garden City, Kansas, in 1949. An overview is presented of the development of irrigation research for field crop production, primarily during the period of major irrigation expansion extending from the drought of the 1950's to the present.

Primary emphasis is given to the work of the Agricultural Research Service at Bushland, Texas. Subjects discussed include preplant irrigation, conservation tillage, irrigation water intake, wheel compaction of irrigation furrows, a limited irrigation-dryland system with field runoff control, irrigation system losses to tailwater runoff and deep profile drainage, irrigation amounts and soil profile storage, water management and use by three major irrigated crops (grain sorghum, corn, and winter wheat), and irrigation management in relation to rainfall. Irrigation research provides technology useful for reducing water demands on the southern Ogallala Aquifer and for optimizing irrigated crop production into the future. (See also W88-04894) (Author's abstract)
W88-04901

WORKING TOGETHER TO SOLVE OUR WATER PROBLEMS,
High Plains Underground Water Conservation District No. 1, Lubbock, TX.
K. Carver.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 123-128.

Descriptors: *Groundwater irrigation, *Irrigation efficiency, *Water conservation, *Groundwater management, *Interagency cooperation, *High Plains, Dikes, Crop production, Groundwater recharge, Public opinion, Water law, Local governments, Regional development, Texas, Groundwater depletion.

The High Plains Underground Water Conservation District No. 1 was created by the Texas State Board of Water Engineers in August, 1950. Later, parts of two more counties were added. Districts are responsible for making and enforcing rules to conserve, preserve, protect, recharge and prevent waste of groundwater. The Texas Departmnt of Water Resources conducted a public opinion survey which showed that the majority of Texans want stronger groundwater laws enforced on a local or regional basis. In order for such a plan to work, cooperation among farmers, urban dwellers and all federal, state, and local agencies is needed. Due to a declining water table, high energy costs, and a semi-arid climate, Texas farmers are attempting to conserve precipitation by using dikes or small dams in the furrows of irrigation ditches. The Texas Department of Water Resources and the three Water Districts on the Texas High Plains are surveying this area to determine the number of diked areas. In cooperation with the USDA Soil Conservation Service, the Water Districts publish a soil moisture deficit map based on neutron readings at 140 sites and conduct efficiency evaluations on pump plants and irrigation equipment. (See also W88-04894) (Geiger-PTT)
W88-04902

OGALLALA AREA OF TEXAS -- LOOKING TO THE FUTURE,
Texas Dept. of Water Resources, Austin.
H. W. Grubb.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 489-497, 2 fig.

Descriptors: *Groundwater irrigation, *Groundwater management, *Texas, *Ogallala Aquifer, *Groundwater recharge, *Water management, *Water conservation, Playas, Desalination, Terracing, Irrigation efficiency, High Plains.

The pertinent findings of the Six-State High Plains Study Council, particularly as they affect Texas, are reviewed. Texas has 385 million acre-feet or about 12% of the total 3.25 billion acre-feet of water remaining in the Ogallala Formation underlying the six-state study area. More than two-thirds of that water in storage beneath irrigable acreage in Texas is projected to be used in the next 40 years. With fill implementation of presently known conservation potentials, Texas High Plains irrigated acreages would decline from 5.7 million in 1980 to 5.5 million in 2000, and 4.9 million in 2020. Irrigation conservation practices already in use include scheduling irrigations to meet plant needs; using moisture sensors to identify soil moisture conditions; improving the efficiency of wells, pumps, motors, and distribution systems; using furrow dikes; and using low energy drip irrigation methods. Irrigators are laying underground pipe, capturing and reusing tailwater in return systems, planting more drought-tolerant strains and varieties of crops, and cutting evaporation losses by using plant growth regulators. Reduced tillage methods of cultivation, residue management, terracing, and in some cases deep plowing are being used to store and hold moisutre. Several potential methods for stretching the water supply were not included in the calculations on which the Council's projections are based. These include the recharge of playa lake water, the secondary recovery of water, weather modification, desalting, and brush control. The Six-State study recommendations emphasize water conservation research and demonstration programs to continue to improve both dryland and irrigation production technology in order to increase land and water productivity. The Council recommended financial incentive programs to encourage water conservation. The Council also recommended providing more technical assistance and management information to farmers, to water-using industries, and to the water-using public. (See also W88-04894) (Geiger-PTT)
W88-04927

PRIVATE PROGRAM FOR WETLANDS PROTECTION AND CONSTRUCTION: CHESAPEAKE WILDLIFE HERITAGE EXPERIENCE,
Chesapeake Wildlife Heritage, Easton, MD.
J. E. Gerber.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 344-348.

Descriptors: *Wetlands, *Conservation, *Environmental protection, *Wildlife habitats, Education, Gully erosion, Cultivated lands, Economic aspects, Costs, Agriculture, Chesapeake Wildlife Heritage.

Many 'custom farmers', who have tilled their rented ground for an extended number of years, are in effect the managers of the farm. They manage the farmland for maximum production of corn, wheat, and bean, not a diversity of life. The landowners only visit their farms on summer weekends, vacations, or during the shooting season and thus may have little or no idea about the status of wildlife and wetlands on their farms. They do not see erosion problems in the fields or that ditches are tilled right through, speeding siltation of adjacent wetlands. Only when an erosion problem gets so severe that the farmer cannot till through or around the gully, or a ditch must be cleaned does the farmer go to the landowner and explain the need for the landowner to pay for 'conservation work.' Yet the farmer prefers not to bother the landowner with high cost management techniques. If farm operation is perceived by a landowner to be financially burdensome, he may try to get another farmer to till the ground. The net result of this relationship between absentee or non-farming landowners and the local farmers is that the farmer calls the shots on the farm. The first step in establishing conservation practices is to meet with the landowner and discuss the wildlife situation on the farm. Next, a wildlife management plan is written for the landowner that shows how everything from ospreys and bluebirds to waterfowl can be managed on the farm. The program is based on wetland construction because waterfowl and shore birds are highly desirable to landowners for economic, social, aesthetic and recreational reasons. Probably the most important part of the program involves taking the landowner around his farm and then to other farms for a 'hands on' look at what is being done, can be done, and should be done. Chesapeake Wildlife Heritage and similar organizations have a role in educating the landowners about the value of wetlands so that political support for state and federal wetlands protection will increase as will private efforts on private land during this time. (See also W88-04934) (Lantz-PTT)
W88-04975

URBAN STORMWATER HARVESTING: APPLICATIONS AND HYDRAULIC DESIGN,
Georgia Univ., Athens. School of Environmental Design.
For primary bibliographic entry see Field 3B.
W88-05066

RELATIVE EFFICIENCY OF AGRICULTURAL SOURCE WATER POLLUTION CONTROL POLICIES,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5G.
W88-05067

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOOD FORECASTING: DANES UPDATE DAMODAR SYSTEM,
Danish Inst. of Applied Hydraulics, Hoersholm.
For primary bibliographic entry see Field 2E.
W88-04520

IMPLICIT STOCHASTIC MODEL FOR RESERVOIR YIELD OPTIMIZATION,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W88-04596

INCREASING THE ECONOMIC EFFICIENCY AND AFFORDABILITY OF STORM DRAINAGE PROJECTS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
For primary bibliographic entry see Field 6A.
W88-04708

OPEN TOP DRAIN,
Bethlehem Steel Co., PA.
L. N. Lamphier, and W. A. Meyers.
U.S. Patent No. 4,322,179; March 30, 1982, 4 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1016, No 5, p 1680, March 30, 1982.

Descriptors: *Patents, *Storm drains, *Urban drainage, *Surface drainage, *Drainage systems, *Culverts, Pipes, Concrete construction, Paving.

A corrugated metal open top drain pipe removes large quantities of surface water from paved areas without presenting hazards to vehicles. The drain comprises a cylindrical culvert with longitudinally spaced openings on its upper side for the entry of water. Supports extend from the ends of the openings and a serpentine bar spaced vertically above the openings in a horizontal plane is secured to the upper ends of the supports. The bar is embedded in concrete. A block of plastic extends from the openings upwardly to encase a portion of the bar. (Cremmins-AEPCO)
W88-04728

DEVELOPMENT OF DYNAMIC NON-HORTONIAN WATERSHED MODELS FOR STEEPLY SLOPING FORESTED WATERSHEDS: APPLICATION TO EASTERN KENTUCKY,
Kentucky Water Resources Research Inst., Lexington.
L. E. Ormsbee, and A. Q. Khan.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128137/AS. Price codes: A06 in paper copy, A01 in microfiche. Research Report No. 168, August 1987. 112 p, 9 tab, 53 fig, 92 ref, append. Contract No. USGS 14-08-G1019-02 (FY-85) and 14-08-G1227-02 (FY-86).

Descriptors: *Kentucky, *Watershed models, *Forested watersheds, *Water management, Run-

offf forcasting, Runoff, Forest hydrology, Model studies, Hydrograph models, West Virginia, Simulation analysis.

A comprehensive conceptual watershed model was developed to simulate the hydrologic response of steeply sloping forested watersheds. Two non-Hortonian and two Hortonian models were first tested with data from selected watersheds in West Virginia and eastern Kentucky in order to understand the difference mechanisms of flow responsible for storm hydrograph generation in this type of watershed. The two non-Hortonian models tested were the kinematic storage model (Sloan et al. 1983) and the saturation deficit model (Beven and Wood, 1983). Both models were unable to reproduce adequately the observed hydrographs in the four forested watersheds considered in this research. The two Hortonian models tested were Clark's unit hydrograph model and Snyder's unit hydrograph model. These two models were able to reproduce the observed hydrographs only through model calibration with unrealistic parameter values. Based on the conclusions from the testing of the two non-Hortonian and two Hortonian models, a simple conceptual comprehensive watershed model was developed for predicting storm hydrograph from small, steeply sloping forested watersheds. The conceptual model incorporates all types of flow processes including macropore flow (quick response subsurface flow). An evaluation of the resulting model was made using the data from the previously mentioned four watersheds in West Virginia and eastern Kentucky. The model predicted with reasonable accuracy the response of these watershed to precipitation. The results indicate that the model is capable of simulating the hydrologic response of this type of watersheds while at the same time depicting the actual flow mechanism in play. (Huffsey-U. KY-WRRI)
W88-04744

MULTIVARIATE STOCHASTIC FLOOD ANALYSIS USING ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-04760

COMPARATIVE EVALUATION OF THE ESTIMATORS OF SOME FLOOD FREQUENCY MODELS USING MONTE CARLO SIMULATION,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-04763

RELIABILITY OF RESERVOIR OPERATION UNDER HYDROLOGIC UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
H. Lee, E. D. Brill, and J. C. Liebman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-104716/AS. Price codes: A09 in paper copy, A01 in microfiche. WRC Research Report No. 207, July 1987. 172 p, 24 fig, 15 tab, 85 ref. Illinois Water Resources Center, Urbana-Champaign, UILU-WRC-87-207. Contract No. 14-08-0001-G1223. Project No. USGS G1223-05.

Descriptors: *Risk, *Simulation analysis, *Model studies, *Stochastic dynamic programming, *Optimal reservoir control, *Reservoir operation rule curve, *Sensitivity analysis, Reliability, Monte Carlo method, Illinois, Lake Shelbyville.

Sensitivity analyses were performed to examine typical stochastic programming (SP) modeling issues for a hypothetical single reservoir system. The elements considered include the partitions of inflow and storage states, the hydrologic characteristics of inflows, the types of system performance functions, and the tradeoffs between conflicting objectives. Simulation studies were conducted to verify the modeling outcomes and to provide insights for possible improvements of the system performance. A case study of Lake Shelbyville, Illinois was then conducted based on the findings of sensitivity analyses for the hypothetical reservoir system using SP. An ad hoc approach was used to estimate accurately the agricultural and property damages in the optimization procedure. The optimal pool levels of Lake Shelbyville in the summer months were found to be roughly 2 to 5 ft lower than the current target level which is 599.7 ft. Generally, it would take more than one month for Lake Shelbyville to resume the summer pool from the winter drawdown level. Therefore, a transition period longer than one month between the winter drawdown and the summer recovery of lake levels is recommended for consideration if future modification is made in the rule curve. (Stout-IL, WRC)
W88-04766

HEAD CONTROL STAND,
For primary bibliographic entry see Field 3F.
W88-04784

FLOW COMPENSATED COMPUTING CONTROLLER,
E. J. Farmer.
U. S. Patent No. 4,498,809; February 12, 1985, 7 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1059, No 4, p 1770, February 12, 1985.

Descriptors: *Patents, *Flow discharge, *Canals, *Flow control, *Water levels, *Control systems, Flow channels, Gates, Automation, Electrical equipment.

A flow compensated controller for use in automatically controlling the water level in an open channel reduces spillage and operating costs by eliminating work done by water masters. An electrical signal received from a transducer at a measuring location and corresponding to the actual water level in the channel at that location is amplified and compared with an amplified signal corresponding to the desired water level. An error signal corresponding to the difference between the two signals is fed into a proportional amplifier and also an automatic reset unit. The outputs of the proportional amplifier and the automatic reset unit are fed into a summing amplifier. The output of the summing amplifier is fed into a motor modulation driver whose output is connected to a pair of gate operator relays, one relay for responding to a control signal to cause the operator to move the gate in one direction and the other relay to cause the gate operator to move the gate in the other direction. The two relays are connected to the gate operator through a third relay which is controlled by an oscillator driven time proportioning comparator. (Cremmins-AEPCO)
W88-04785

WEED SCREEN AND TRASH ELIMINATOR,
For primary bibliographic entry see Field 3F.
W88-04814

ARCH END CAP,
Hancor, Inc., Findlay, OH.
J. L. Fouss, and J. J. Parker.
U. S. Patent No. 4,445,542; May 1, 1984, 6 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1042, No 1, p 122, May 1, 1984.

Descriptors: *Patents, *Irrigation engineering, *Drainage systems, *Conduits, Obstruction to flow, Rodents, Plastics, Agricultural engineering.

An end cap obstructs the ingress of ambient materials to an arched plastic drainage conduit for agricultural drainage. The end cap comprises two arcuate side walls and two end walls. The side walls contain apex, base, and terminal end areas. The two apex areas are joined to form an end cap apex. Protruding ribs are disposed circumferentially of the end cap and are interrupted at the apex area to provide a relatively smooth, non-ribbed area. The ribs taper toward the apex area and the rounded base areas of the side walls. (Cremmins-AEPCO)
W88-04825

DRAINAGE CHANNEL WITH MEANS FOR MAINTAINING PROPER SLOPE DURING INSTALLATION,
Polydrain, Inc., Troutman, NC.
L. E. Kirkpatrick, and B. C. Williams.
U. S. Patent No. 4,498,807; February 27, 1985, 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1051, No 2, p 622-623, February 12, 1985.

Descriptors: *Patents, *Drainage canals, *Construction methods, *Concrete construction, *Open-channel drainage, *Surface drainage, Anchors, Slope stabilization, Trenches.

A drainage channel in concrete is anchored to maintain proper slope during installation. The anchor system includes one long spike for insertion into the earth defining the trench, a clasp carried by the spike, and connectors carried by the outer walls of the channel for connecting to and cooperating with the clasp to retain the channel at its proper slope to prevent it from floating upward in the unhardened concrete. The connectors comprise an outwardly projecting rib extending along the length of the channel. The clasp includes a detent for placement over the upper surface of the rib in the channel. (Cremmins-AEPCO)
W88-04826

DRAIN PIPE,
G. W. Soderstrom.
U. S. Patent No. 4,389,138; June 21, 1983, 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1031, No 3, p 931, June 21, 1983.

Descriptors: *Patents, *Drainage systems, *Controlled drainage, *Pipes, *Clogging, Conveyance structures, Casings, Mud, Rain, Flow discharge.

An easy to manufacture and mount drain pipe prevents clogging by mud. The system comprises an outer pipe casing, at least one longitudinal opening in a lower surface of the casing, a wall extending upwardly from each longitudinal edge of one opening to form a water riser space between the walls to drain water, and openings at the upper edges of the walls. The walls are connected to an upper inside surface of the pipe case to allow water flow into the channels formed between the walls and the pipe casing. (Cremmins-AEPCO)
W88-04827

MULTI-LAYERED CORRUGATED CONDUIT WITH 'BLACK-EYE' LIKE APERTURES,
Hancor, Inc., Findlay, OH.
J. L. Fouss, J.J. Parker, J. L. Child, and D. W. Sting.
U. S. Patent No. 4,523,613; June 18, 1985, 7 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1055, No 3, p 1083, June 18, 1985.

Descriptors: *Patents, *Irrigation engineering, *Drainage systems, *Conduits, Plastics, Pipes, Tubes, Drainage engineering, Agricultural engineering.

A multi-layered, corrugated plastic drainage conduit removes excess water from agricultural fields. The conduit comprises a longitudinally extending multi-layered, corrugated side wall. The wall comprises at least a conduit inner layer of a first plastic material and a conduit outer layer of a second material. The corrugated side includes transversely extending alternating peaks and valleys, each peak having an outermost wall portion extending around the conduit and a width extending longitudinally. The conduit also contains a first longitudinally extending row of apertures defined in the peak outermost wall portions. Each aperture is defined by an opening in the outer layer which has a peripheral ring of the first material extending through it. The aperture is defined in and surrounded completely by the first plastic material. (Cremmins-AEPCO)
W88-04837

RODENT BARRIER DEVICE,
R. A. Miles.

U. S. Patent No. 4,356,087; October 26, 1982, 4 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1023, No 4, p 1345, October 26, 1982.

Descriptors: *Patents, *Barriers, *Tile drains, *Drainage systems, *Rodents, Tile drainage, Drainage water.

Installation of a barrier device in a drain tile for water from tillable fields prevents the entry of small animals into the tile. A water pervious gate mounted in the drain tile both pivotally swings to an open position when engaged by water and tank trained debris and also swings to an obstructing position by gravity action to prevent the small animals from entering the tile. The barrier device includes spaced elements affixed to a sleeve to define the perforate gate. The elements are in the form of rods. (Cremmins-AEPCO)
W88-04838

COMPLEX STORM SEWER PROJECT AIDED BY INNOVATIVE PIPE DESIGN,
Middletown, OH.
W. F. Klosterman.
Public Works PUOAH, Vol. 118, No. 11, p 53-54, November 1987.

Descriptors: *Environmental engineering, *Road drainage, *Storm water, *Pipelines, Drainage ditches, Pipe flow, Highway, Cost analysis.

An open storm-water drainage channel was replaced with 60-inch diameter pipe to permit the widening of an adjacent highway and eliminate problems of mosquitoes and water-borne bacteria. Use of 60-inch concrete-lined steel pipe with superior hydraulic characteristics was chosen instead of 66-inch diameter corrugated pipe because the former required less disturbance along the route, and provided a 50% cost saving due to quicker installation. An asphalt coating was field applied to the pipe exterior to give extra protection in the corrosive soils on the pipeline route. Fourteen years after installation, annual inspection of the 2000-foot storm sewer reveals that the pipe is in good conditions. (Rochester-PTT)
W88-04871

LARGE LAKE MODELS - USES, ABUSES, AND FUTURE,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
For primary bibliographic entry see Field 2H.
W88-05038

4B. Groundwater Management

POLITICS OF GROUND-WATER MANAGEMENT REFORM IN OKLAHOMA,
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 6E.
W88-04487

GROUNDWATER GEOCHEMISTRY OF AQUIFER THERMAL ENERGY STORAGE: LONG-TERM TEST CYCLE,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2K.
W88-04602

EFFECT OF THE 1986 DROUGHT ON THE MISSISSIPPI RIVER ALLUVIAL AQUIFER,
Mississippi Bureau of Land and Water Resources, Jackson.
For primary bibliographic entry see Field 2F.
W88-04671

USDA-SOIL CONSERVATION SERVICE IRRIGATION WATER MANAGEMENT PROGRAM IN MISSISSIPPI,
Soil Conservation Service, Greenwood, MS.
For primary bibliographic entry see Field 3F.
W88-04672

WATER MANAGEMENT DISTRICT,
Delta Council, Stoneville, MS.
W. Harrison, and C. Morgan.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 33-35.

Descriptors: *Water management, *Mississippi delta, *Water districts, *Groundwater management, *Water use, Water demand, Legislation, Permits, Regulations.

The Mississippi Delta is endowed with abundant groundwater resources to serve agriculture, industry and municipal water supplies. In the last two decades agricultural and industrial technology has changed, creating increased demands on this natural resource. The aquifer thickness is less at the river and the bluffs than in the geographical middle of the Delta. This physical characteristic is true for the entire length of the Delta. In the early 1970's use of water from the alluvial aquifer in the Delta averaged approximately 200 million gallons/day. By the early 1980's this usage had increased to an average of 1,100 million gallons/day. In 1985 and 1986, this average rate was even higher. Because of this increased average usage, Delta Council initiated a comprehensive quantitative study of approximately 500 well sites in the Delta. Measurements included the thickness of the aquifer, the amount of water being withdrawn, and a simulated computer model on the effects on projected groundwater uses through the remainder of this century. Data gathered by monitoring these well sites allowed the Geological Survey to offer some data for future planning. In 1983, after a three-year study period, the results were presented to Governor William Winter. In 1984, the State Water Management Council presented two Bills before the Mississippi Legislature which were adopted into law by overwhelming margins of support. House Bill 762, which became known as the 'Omnibus Water Bill' or General Legislation and, provides language to include State groundwater policy with existing surface water laws that have been enforced since 1957. House Bill 149, is the enabling legislation set up to allow the formation of Water Management Districts in areas of the State that wish to have input and direction in the management and conservation of their resources. The governing body of the Water District will consist of one elected commissioner from each county. This governing method is appropriate because the value placed on water resources in all counties is equal and because every county in this region will be affected if proper management is not applied with a high degree of uniformity in all of the counties collectively and individually. All commissioners will be elected through a public election process provided for in the statutes of House Bill 149. (See also W88-04665) (Lantz-PTT)
W88-04673

MIOCENE GROUNDWATER OVERDRAFT IN SOUTHERN MISSISSIPPI,
Nevada Univ. System, Reno. Water Resources Center.
P. R. Fenske.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 83-87, 4 fig, 1 tab, 19 ref.

Descriptors: *Groundwater recession, *Mississippi, *Miocene, *Overdraft, *Groundwater recharge, Water resources development, Water levels, Aquifers, Groundwater level.

Water level declines in the Miocene aquifer system of approximately one foot or more per year have often been reported in the literature on Mississippi water resources. Data relative to water level declines in the area of Tatum Dome, 9 miles west of Purvis, Mississippi, are presented. The main thrust is to present data from holes currently monitored on Tatum Dome by the EPA, along with historical measurements in the same area to show the water level declines over a period of approximately 25 years. Although the constant rate of drawdown suggests that significant overdraft is taking place, consideration of the extensive outcrops and subcrops of the Miocene aquifer along with the high precipitation rate, high infiltration potential and consequent high recharge potential indicate that the production of groundwater in Mississippi could be significantly higher than at present without causing an overdraft. The decrease in the water level in the aquifers is a transient situation which will persist until the cones of depression related to the extraction points are broad enough to capture a flow field equal to the extraction of groundwater in that area. When this happens the water levels will probably stabilize, although at a different time for different extraction points. Because of the nature of the geohydrology of the Miocene aquifer, interference between major extraction points is not considered to be a significant future problem. (See also W88-04665) (Lantz-PTT)
W88-04681

APPLICATION OF A LAYERED GROUNDWATER MODEL TO CRITICAL AREAS IN NORTHEAST MISSISSIPPI,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
V. L. Zitta, and T. K. Pang.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 89-94, 6 fig, 2 tab, 15 ref. US Dept. of Interior Project No. G1026.

Descriptors: *Groundwater level, *Model studies, *Mississippi, *Groundwater management, Mathematical models, Aquifers, Hydrologic properties, Pumping, Geohydrology, Selective withdrawal.

A modular, three-dimensional, finite-difference groundwater flow model developed by McDonald and Harbaugh was applied to the Eutaw-McShan aquifer in Northeast Mississippi. Based upon the analysis of electric logs, the geometry of the aquifer was refined for input into a 2.5 mile square grid. Pumping data were obtained from municipalities and industries as a check and confirmation of estimated values presented in a variety of publications. Based upon the work performed in this study, the following conclusions are drawn: (1) a 2.5 mile square grid model of the Eutaw-McShan aquifer is adequate to define the regions of critical drawdown in Northeast Mississippi; (2) geological logs and available pumping records were available to refine the geometry of the aquifer and withdrawal rates; and (3) agreement is good in comparisons between actual and computed potentiometry maps from aquifer coefficients obtained in this study and those from previous studies agreement is good. (See also W88-04665) (Lantz-PTT)
W88-04682

SIMULATION OF THE FLOW SYSTEM IN THE SHALLOW AQUIFER, DAUPHIN ISLAND, ALABAMA,
Geological Survey, Tuscaloosa, AL.
For primary bibliographic entry see Field 2F.
W88-04684

SALINE WATER OCCURRENCE WITHIN THE TERTIARY SPARTA SAND AND COCKFIELD AQUIFERS OF WASHINGTON COUNTY, MISSISSIPPI,
Mississippi Bureau of Land and Water Resources, Jackson.
For primary bibliographic entry see Field 2F.
W88-04685

GROUNDWATER MANAGEMENT UNDER THE APPROPRIATION DOCTRINE, PART II,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
For primary bibliographic entry see Field 6E.
W88-04761

PROCEEDINGS OF THE OGALLALA AQUIFER SYMPOSIUM II,
Texas Tech Univ., Lubbock. Water Resources Center.
R. M. Sweazy, and A. W. Wyatt.
Lubbock, Texas, June 1984. 1984. 593 p. Edited by George A. Whetstone.

Descriptors: *Groundwater management, *Groundwater recharge, *Ogallala Aquifer, *Groundwater irrigation, *Groundwater depletion, Groundwater runoff, Artificial recharge, Groundwater budget, Groundwater recession, Groundwater mining, Groundwater pollution, Aquifer management, Texas, Nebraska, New Mexico, Playas.

The Ogallala Aquifer Symposium II held in Lubbock, Texas in June of 1984 was a continuation of research reported in the first Ogallala Aquifer Symposium held in 1970. The 1984 symposium featured eight sessions. In Session I, the USGS High Plains Study, geohydrology, estimation of 1980 groundwater pumpage for irrigation, mapping of irrigated agriculture using landsat data, and flow system simulation are discussed. In Session II, economics and irrigation are examined. Sessions III and IV, Geology and Hydrogeology, updated interpretations of the deposition and behavior of the aquifer and of playa lakes, discussed improved means for rapid and accurate determination of physical parameters, assessed the groundwater resources in Texas and Nebraska, and described the application of computer software in improving the efficiency of deep well pumping. Session V discussed recharge of the Ogallala Aquifer through excavated basins, recharge through playa lake basins, recharge from the Northern High Plains of Colorado, recharge with playa lake water and filter underdrains, and estimated recharge using chloride in the unsaturated zone of Curry County, New Mexico. Session VI investigated aquifer interactions and groundwater pollution. Session VII examined the legal aspects of groundwater law and aquifer use. Session VIII explored production of water from the unsaturated zone (secondary recovery). Two symposium field trips are also discussed. (See W88-04895 thru W88-04933) (Geiger-PTT)
W88-04894

HIGH PLAINS REGIONAL AQUIFER -- GEOHYDROLOGY,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W88-04895

HIGH PLAINS REGIONAL AQUIFER -- ESTIMATING 1980 GROUND-WATER PUMPAGE FOR IRRIGATION,
Geological Survey, Lakewood, CO.
F. J. Heimes.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 26-39, 3 fig, 4 tab, 6 ref.

Descriptors: *Groundwater irrigation, *High Plains Regional Aquifer, *Groundwater mining, *Groundwater management, *Systems analysis, Aquifer management, Pumpage, Regional analysis, Mathematical models, Irrigation requirements, Satellite technology, Irrigation efficiency.

Information about current trends in groundwater use for irrigation is required for the High Plains Regional Aquifer-System Analysis. Because available water-use information is inadequate, an approach based on field sampling was used to estimate groundwater pumped for irrigation throughout the High Plains during the 1980 growing season. The volume of groundwater pumped for irrigation was computed by combining sampled water-application measurements with mapped irrigated-acreage information. Irrigation application (inches of water applied) was measured at 480 sites in 15 counties in the High Plains during the 1980 growing season. Relationships between irrigation demand, calculated using the Blaney-Criddle consumptive-use formula, and measured application were used to estimate application for unsampled areas of the High Plains. The estimated application was calculated for each 1-degree latitude by 1-degree longitude area in the High Plains. Application estimates, derived from analysis of Landsat-satellite imagery, yielded the volume of groundwater pumped for irrigation. Estimates of water pumped for irrigation during 1980 were aggregated by state and as a total estimate for the entire High Plains. The estimate of water pumped for irrigation in the High Plains during 1980 was 17,980,000 acre-feet applied to 13,700,000 acres. Texas had the most dense irrigation development in the High Plains, whereas South Dakota was virtually undeveloped. The application data derived from sampling were evaluated for significant trends. The data indicated a greater application for such crops as corn and hay and a lesser application for such crops as sorghum, grain and cotton. The data also indicated greater pumpage for flood-irrigation systems than for sprinkler-irrigation systems. Areas of the High Plains with thin saturated thickness tended to have a smaller average discharge per well, fewer irrigated acres per well, and a predominance of crops requiring less water. (See also W88-04894) (Author's abstract)
W88-04896

HIGH PLAINS REGIONAL AQUIFER -- MAPPING IRRIGATED AGRICULTURE USING LANDSAT DATA,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
For primary bibliographic entry see Field 7B.
W88-04897

HIGH PLAINS REGIONAL AQUIFER -- FLOW-SYSTEM SIMULATION OF THE CENTRAL AND NORTHERN HIGH PLAINS,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2F.
W88-04898

GENERALIZED METHOD FOR ECONOMICALLY EVALUATING IRRIGATION DECISIONS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W88-04899

ECONOMIC EVALUATION OF THE OGALLALA AQUIFER IN OKLAHOMA: WHAT DOES THE FUTURE HOLD,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W88-04900

IRRIGATION WATER MANAGEMENT RESEARCH -- SOUTHERN OGALLALA REGION,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 3F.
W88-04901

WORKING TOGETHER TO SOLVE OUR WATER PROBLEMS,
High Plains Underground Water Conservation District No. 1, Lubbock, TX.
For primary bibliographic entry see Field 3F.
W88-04902

ASSESSMENT OF THE GROUND-WATER RESOURCES OF THE TEXAS HIGH PLAINS,
Texas Dept. of Water Resources, Austin. Data and Engineering Services Div.
For primary bibliographic entry see Field 2F.
W88-04907

HYDROLOGIC CHARACTERISTICS AND GROUND-WATER AVAILABILITY IN THE HIGH PLAINS AQUIFER SYSTEM IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-04908

ESTIMATION OF SPECIFIC YIELD USING DRILLERS' LITHOLOGIC DESCRIPTIONS,
Texas Dept. of Water Resources, Austin. Data Collection and Evaluation Section.
For primary bibliographic entry see Field 2F.
W88-04909

HYDRAULIC CHARACTERISTICS OF THE HIGH PLAINS AQUIFER AS DETERMINED FROM CORE ANALYSIS,
Texas Dept. of Water Resources, Austin. Data Collection and Evaluation Section.
For primary bibliographic entry see Field 2F.
W88-04910

USE OF COMPUTER SOFTWARE TO IMPROVE THE ENERGY EFFICIENCY IN DEEP WELL WATER PUMPING,
Amarillo City Water Superintendent, TX.
C. H. Scherer.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 292-303, 3 tab.

Descriptors: *Computer programs, *Pump efficiency, *Deep wells, *Economic efficiency, Operating costs, Pumping tests, Maintenance, Cost analysis, Water conveyance, Texas, Performance evaluation.

The City of Amarillo Water Supply Department has developed a comprehensive program of maintenance and operation that improves the reliability of the water supply system while reducing its operating costs. In collaboration with the Texas Energy and Natural Resources Advisory Council, the City of Amarillo devised a computer software program to select the most energy-efficient combinations of wells for each level of water demand. Programs were initiated to routinely analyze the performance of each individual well in the system, establish a long-range plan for repairing and replacing well pumping equipment to obtain a minimum overall efficiency of 60%, and update all well field operaitng data on a quarterly basis. Based on a requirement of approximately 4,200 million gallons of water per year, it is estimated that the use of this energy-oriented software program will result in a net saving to the City of Amarillo in the Carson County Well Field of approximately $40,000 per year. This program is adaptable to other similar well supply systems. (See also W88-04894) (Geiger-PTT)
W88-04911

PLAYA LAKE BASINS ON THE SOUTHERN HIGH PLAINS OF TEXAS, U.S.A.: A HYPOTHESIS FOR THEIR DEVELOPMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W88-04912

FEDERAL COOPERATION IN RECHARGE AND REPLENISHMENT,
Bureau of Reclamation, Washington, DC.
R. A. Olson.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 312-318.

Descriptors: *Groundwater recharge, *Groundwater management, *Water law, *Project planning, *Ogallala Aquifer, Interagency cooperation, Groundwater depletion, Diversion, Groundwater mining, Interstate trade, Cost analysis, Evaluation, Economic aspects, Management planning, High Plains.

Legislation in the form of H.R. 71 would give non-federal entities a chance to develop projects jointly with the federal government for demonstrating groundwater recharge at 21 sites. A two-phase strategy for such demonstration projects involves nominating, selecting, and planning recharge demonstration projects which the Secretary of the Interior will then submit to Congress (Phase I), and then constructing those projects recommended by the Secretary and approved by Congress (Phase II). The federal share of the program's funding for Phase I activities is currently set at $500,000 and for Phase II at $20 million. Both the Bureau of Reclamation and the Geological Survey will be available to help non-federal entities as they draw up their proposals. Water diversion projects are suggested as one possible long-term solution to the problems of groundwater depletion in the High Plains area. Recent court decisions have indicated

that water is an article of interstate trade protected from state intervention. However, Congress introduced bills in 1983 that sought to reverse that interpretation. Groundwater withdrawals have translated into potential losses that could affect not only farmers, but all U.S. consumers who rely on farm products. (See also W88-04894) (Geiger-PTT)
W88-04913

RECHARGE OF THE OGALLALA AQUIFER THROUGH EXCAVATED BASINS,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
A. C. Schneider, and O. R. Jones.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 319-336, 7 fig, 2 tab, 9 ref.

Descriptors: *Groundwater recharge, *Groundwater management, *Playas, *Ogallala Aquifer, *Recharge basins, Cotton gin trash, Recharge ponds, Artificial recharge, Runoff, Flooding, Filtration, Permeability, Radioactive tracers, Cesium radioisotopes.

With excavated groundwater recharge basins, a layer of slowly permeable surface soil is removed to expose sediments many times more permeable than the soil itself. In initial tests with clear well water, recharge rates were as high as 2.1 meters/day. In subsequent tests with turbid playa water, the initial recharge rates were as high as 1 meter/day. Because of sealing by suspended solids in the playa water, extensive research was conducted in a 0.04-ha basin to investigate sediment penetration into the basin surface and the feasibility of renovating a sealed basin surface. In a study using sediments tagged with Cs134, over 90% of the suspended solids were filtered within 25 mm of the basin surface. Since the sediments were filtered at the surface, they could be removed after they dried and separated from the basin surface. During eleven recharge cycles with the 0.04-ha recharge basin, 132 m of turbid water was recharged at an average rate of 0.433 meter/day. Management practices were then evaluated to reduce maintenance expenses for the basins. Increased depth of flooding and incorporation of an organic mat (cotton gin trash) in the bottom of the recharge basin essentially doubled the amount of turbid water artificially recharged to the Ogallala aquifer. A 0.2-ha excavated basin was tested concurrently for conserving storm runoff that collected in a 16-ha playa. Turbid water was pumped from the playa to the basin during eight recharge cycles over a 7-year interval. The average recharge rate during 187 days of flooding was 0.373 meters/day. After three recharge tests during the first year, the basin bottom was corrugated to make it self-cleaning, and no further maintenance was needed. This extensive research has shown that recharge basins could be an effective technique for partially replenishing the depleted Ogallala Aquifer. (See also W88-04894) (Author's abstract)
W88-04914

RECHARGE TO THE OGALLALA AQUIFER FROM PLAYA LAKE BASINS ON THE LLANO ESTACADO (AN OUTRAGEOUS PROPOSAL),
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W88-04915

POTENTIAL FOR ARTIFICIAL RECHARGE OF THE NORTHERN HIGH PLAINS OF COLORADO,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Warner, D. K. Sunada, and D. B. McWhorter.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 350-366, 24 fig, 1 tab, 8 ref.

Descriptors: *Artificial recharge, *High Plains Aquifer, *Ogallala aquifer, *Groundwater recharge, *Groundwater management, *Colorado, Groundwater irrigation, Groundwater depletion, Groundwater mining, Natural recharge, Dikes, Infiltration, Recharge ponds, Recharge basins, Terracing, Runoff.

A low rate of natural recharge, combined with intensive use of groundwater for irrigation has resulted in a mining of the groundwater in the Ogallala Aquifer in the High Plains area. Artificial recharge can be used to augment natural recharge and extend the life of the Ogallala Aquifer. Three methods of artificial recharge have been investigated in the High Plains area. One of these involves building a series of earth dams and dikes in the stream channel to spread flood flow over a larger area and increase the potential for infiltration. This method was very effective in increasing recharge but had a serious disadvantage in that these dams were subject to damage from very large floods. Use of recharge pits was feasible when a layer of low permeability exists beneath the pit and is overlain by a much more permeable layer of sand or gravel which can act as an underground spreading basin. This is the case in many areas of the High Plains in Colorado. However, sediment accumulation in the pit and also behind the dams was a major problem. Terracing of the land surface can also significantly increase recharge to the aquifer. (See also W88-04894) (Geiger-PTT)
W88-04916

RECHARGE WITH PLAYA LAKE WATER AND FILTER UNDERDRAINS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
L. V. Urban, and B. J. Claborn.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 367-375, 4 fig, 5 ref.

Descriptors: *Ogallala Aquifer, *Playas, *Groundwater recharge, *Artificial recharge, *Subsurface drains, Filters, Groundwater management, Drains, Permeability, Project planning, Field tests, Lake sediments, Induced infiltration, Texas.

The use of wick filter drains for conveying water caught in playa lakes past the virtually impermeable layer of silt and clay to underlying aquifers was studied in laboratory tests. Two concepts for wick configuration and two wick materials were examined. The first configuration positioned the wicks in such a manner that they would extend upward through the playa lake bed and be attached to vertical posts. The other configuration examined wicks that would be placed horizontally in trenches. In the tests of the vertical configuration, the sediments quickly clogged the filter materials, but in the horizontal format, the tests indicated that the filters would serve satisfactorily as underdrains, with the playa lake clay itself serving as a filter medium. The two wick materials tested exhibited a typical infiltration-versus-time relationship. The effectiveness of filter underdrains demonstrated in the laboratory will be tested in a playa lake near Shallowater, Texas. Underdrain design parameters to be tested in conjunction with the filter material are width of drain, thickness of drain, and thickness of lake sediment above the drain. Factors to be evaluated by the tests include rate at which water is made available for recharge, water quality, and serviceability. (See also W88-04894) (Geiger-PTT)
W88-04917

PRELIMINARY ESTIMATES OF OGALLALA-AQUIFER RECHARGE USING CHLORINE IN THE UNSATURATED ZONE, CURRY COUNTY, NEW MEXICO,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
For primary bibliographic entry see Field 2F.
W88-04918

DOE HIGH-LEVEL NUCLEAR WASTE REPOSITORY PROGRAM -- AQUIFER IMPACTS,
Texas Office of the Governor, Austin. Nuclear Waste Programs Office.
For primary bibliographic entry see Field 5E.
W88-04920

RISING WATER LEVELS -- AN ASSET AND A LIABILITY TO TEXAS TECH UNIVERSITY,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
M. J. Dvoracek.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 412-415.

Descriptors: *Groundwater level, *Groundwater management, *Water table rise, *Dewatering, Unconfined aquifers, Ogallala Aquifer, Groundwater movement, Project planning, Management planning, Groundwater recharge, Texas, Wells.

Water levels within the Ogallala Aquifer beneath the Texas Tech University have been rising over the past several years creating a near-surface groundwater mound beneath the campus. The rising water table levels pose potential problems to existing campus buildings and facilities. Plans to mitigate the problems include: the establishment of an Office of Water Management on campus to continue close monitoring of the situation; the drilling of additional dewatering wells at strategic points on campus; using the pumped water beneficially; constructing a new reservoir on the agricultural lands to better retain treated sewage from the city of Lubbock, Texas; and evaluating possible future steps as conditions warrant them. Five of the 22 existing wells on campus are used for dewatering. Additional wells will provide further water for landscaping and a substitute supply for water now purchased for heating and cooling purposes. (See also W88-04894) (Geiger-PTT)
W88-04921

RISING GROUNDWATER LEVELS, TEXAS TECH UNIVERSITY,
Camp, Dresser and McKee, Inc., Austin, TX.
R. S. Kier, L. S. Stecher, and R. J. Brandes.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 416-439, 3 fig, 17 ref.

Descriptors: *Groundwater level, *Water table Rise, *Hydrologic models, *Groundwater management, *Ogallala Aquifer, Groundwater irrigation, Computer models, Wastewater disposal, Mathematical models, Groundwater movement, Dewatering, Geohydrology, Playas, Mapping, Wells, Texas.

Elevations in the groundwater level in the vicinity of Texas Tech University pose a threat to the foundations of campus buildings. A groundwater level map for the Ogallala Aquifer in Lubbock County suggests that the groundwater beneath the University is part of a large groundwater mound which underlies the entire western half of the City of Lubbock. Data on geology, historic water levels, and sources and sinks of groundwater were compiled and evaluated to formulate a conceptual model describing the groundwater flow system. From the conceptual model, a computer-based dynamic, numerical groundwater flow model was developed to provide a basis for prediction of future groundwater behavior. The model is a finite-element, quasi-three-dimensional flow model operated in a single layer configuration with nodes and elements selected to correspond to major buildings, playas, and storage facilities. The available water level data confirm that the groundwater mound beneath Texas Tech University is part of a single, integrated Ogallala Aquifer system. The origin of the mound is related to multiple factors. Leakage from playas within the City of Lubbock constitutes the single largest source of recharge. Leakage and spillage from the University's wastewater effluent storage ponds also contribute to the mound, but the amount is relatively small in comparison to the amount of playa recharge. Reduction in groundwater usage has contributed to growth of the mound. The calibrated model was used to predict future water levels of the groundwater mound to determine which structures on the campus were in the most jeopardy. Operation of the 6th Street dewatering well will help maintain the integrity of Jones Stadium. (See also W88-04894) (Geiger-PTT)
W88-04922

OIL-FIELD BRINE CONTAMINATION--A CASE STUDY, LEA COUNTY, NEW MEXICO,
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 5B.
W88-04923

DEPLETING THE OGALLALA: HIGH PLAINS GROUND WATER MANAGEMENT POLICIES,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
J. D. Aiken.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 451-464.

Descriptors: *Groundwater management, *Groundwater depletion, *Legislation, *Ogallala Aquifer, *Groundwater irrigation, *Water policy, Project planning, Water law, Regulations, Management planning, Groundwater mining, Water rates, High Plains, User charges.

The typical regulatory response to groundwater depletion in the West has been authorizing special regulation of groundwater development and use in designated critical groundwater areas. Critical area legislation is aimed at slowing or stopping groundwater depletion and protecting local irrigation-based economies. Texas, New Mexico, Kansas, Colorado and Nebraska have critical area legislation. In Oklahoma, the only High Plains state without critical area legislation, groundwater withdrawals are regulated by state-established allocations which must be consistent with a minimum aquifer life. In Arizona, no new wells may be installed in designated areas. Mandatory reductions in irrigation water use are phased in over successive decades with the goal of balancing withdrawals, supply augmentation and recharge by 2025. Revenues raised from water use charges can be used to purchase and retire groundwater rights. In the past, High Plains states have avoided the politically unpopular step of regulating existing groundwater users to limit or prevent groundwater depletion. Groundwater irrigators have instead expected to receive supplemental irrigation water from a publicly subsidized surface water project. Reductions in federal spending for such projects suggest that irrigators will be required to pay higher prices for project water in the future if they manage to obtain a project at all. These water policy changes may force irrigators to consider restrictions of groundwater use as a viable alternative for dealing with groundwater depletion and lead to more realistic groundwater policies. (See also W88-04894) (Author's abstract)
W88-04924

LEGAL ASPECTS OF GROUNDWATER MANAGEMENT IN THE OGALLALA AREA,
McCleskey, Harringer, Brazill and Graf, Lubbock, TX.
For primary bibliographic entry see Field 6E.
W88-04925

STATE WATER PLANNING -- THE MULTIPLE CHOICE APPROACH,
Nebraska Univ.-Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 6A.
W88-04926

OGALLALA AREA OF TEXAS -- LOOKING TO THE FUTURE,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 3F.
W88-04927

SECONDARY RECOVERY OF CAPILLARY WATER,
High Plains Underground Water Conservation District No. 1, Lubbock, TX.
A. W. Wyatt.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 500-513, 3 fig.

Descriptors: *Water supply development, *Groundwater management, *Capillary water, *Groundwater mining, *Ogallala Aquifer, Groundwater depletion, Water conservation, Project planning, Economic evaluation, Soil water, Groundwater movement, Interstitial water, Field tests.

The Texas Legislature appropriated funds to the Texas Department of Water Resources to study the feasibility of recovering capillary water in storage in the Ogallala Formation (secondary recovery). From core analyses it was determined that capillary water in storage in the Texas portion of the aquifer ranged from 10 to 40% by volume, and averaged 25.9%. A literature search indicated strongly that air drives, use of surfactants, and other methods exist which can drive much of this water to the water table, from where it can be pumped. Three field tests verified the effectiveness of air drives for secondary recovery of water. An economic analysis of the third test indicated that the estimated 406 acre-feet of increased groundwater had cost somewhat less than $50 per acre-foot. A fourth test at Wolfforth, Texas is investigating the possibility of reducing costs by reducing air pressure in the air drives. (See also W88-04894) (Geiger-PTT)
W88-04928

SLATON AND IDALOU FIELD TESTS IN THE SECONDARY RECOVERY OF WATER FROM THE OGALLALA,
Rauschuber (Donald G.) and Associates, Inc., Manchaca, TX.
D. G. Rauschuber.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 514-527, 6 fig, 12 ref.

Descriptors: *Ogallala Aquifer, *Groundwater mining, *Capillary water, *Water supply development, *Air injection, *Groundwater management, Feasibility studies, Soil water, Field tests, Project planning, Injection, Groundwater storage, Groundwater depletion, Groundwater movement, Texas.

Two of the goals formally specified in the project undertaken by the High Plains Underground Water Conservation District No. 1, the Texas Department of Water Resources, and the Texas Tech University Water Resources Center for the investigation of secondary recovery of groundwater from the Ogallala Formation underlying the High Plains of Texas were to develop plans for conducting pilot programs to test one or more of the capillary water recovery techniques being technologically and economically feasible; and, if possible, field test one or more of the capillary water recovery techniques to verify technological and economic feasibility. These objectives were accomplished in three steps. The first consisted of a pre-test at Slaton, Texas to validate the concept and the adequacy of the wells, compressors, and metering devices to obtain meaningful data. The second was an air-injection test at Slaton on the basis of modification in the equipment and procedures indicated in the pre-test. The third step consisted of a highly satisfactory air injection program at Idalou, Texas, in which the injection of some 10 million cubic feet of air into a vadose stratum underlying four distinct clay layers, one of which supported a perched water table, resulted in the presence of an additional 406 acre-feet of water in storage 160 days after the air injection ceased. (See also W88-04894) (Author's abstract)
W88-04929

SCIENTIFIC AND ECONOMIC RESEARCH IN SUPPORT OF THE INVESTIGATION OF SECONDARY RECOVERY OF GROUND WATER,
Texas Tech Univ., Lubbock. Water Resources Center.
R. M. Sweazy.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 528-534, 6 ref.

Descriptors: *Groundwater mining, *Air injection, *Water supply development, *Groundwater management, *Unsaturated zone, *Capillary water, Surfactants, Interstitial water, Mathematical models, Groundwater potential, Water conservation, Cost analysis, Field tests, High Plains.

An attempt was made to drive water from the unsaturated zone by air pressure to the water table as a means of augmenting water supply in an aquifer. Laboratory testing early in the project included an evaluation of the effectiveness and costs of surfactants. While surfactants do increase the yield of water, they tend to be adsorbed rather quickly and are too costly for practical use. Mathematical models were constructed to aid in understanding the mechanics of water retention and release in an unsaturated porous medium (sand-filled cylinder). A cost analysis based on the field tests indicated that the additional water produced within a period of 160 days after cessation of air injection would cost about $46.50 per acre-foot. Research projects will continue in cooperation with the High Plains Underground Water Conservation District No. 1 to combine secondary recovery with an effective recharge program. (See also W88-04894) (Geiger-PTT)
W88-04930

USE OF SURFACTANTS TO PROMOTE DRAINAGE WITHIN A DEWATERED ZONE,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
R. E. Zartman, and R. A. Bartsch.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 535-542, 1 fig, 2 tab, 5 ref.

Descriptors: *Surfactants, *Capillary water, *Groundwater mining, *Water supply development, *Ogallala Aquifer, Groundwater management, Subsurface drainage, Groundwater potential, Artificial recharge, Unsaturated zone, Groundwater movement, Interstitial water, Groundwater irrigation.

In recent years, demand for irrigation water has increased while its availability has diminished. At the present time the Ogallala Aquifer is being mined, but not all of the water is being removed. The remaining water is held in the soil by capillary action which results from adhesion and cohesion. Water-soluble surfactants are capable of reducing surface tension which would thereby allow water to drain from the soil more completely. In laboratory tests surfactant solutions were added, at 60% of pore volume as a slug, to the top of dewatered sand columns (0.1 m diameter by 0.5 m length). Prior to each run, the columns were flushed with three pore volumes of tap water alternating with two pore volumes of methanol. The twenty-five surfactants tested were added at concentrations of 0.0, 0.001, 0.01, 0.1, 1.0 and 10% on a weight/volume or volume/volume to water basis. Analysis of the amount of liquid which passed through a column revealed a pronounced dependence upon the identity and type of surfactant, concentration of surfactant, and surfactant by concentration interaction. Surfactants were evaluated by ionic class with nonionic and anionic surfactants proving to be more effective than cationic surfactants. The higher the concentrations of surfactant added, the greater the throughput. The surfactant-by-concentration data indicated that the anionic surfactants were more effective than nonionic or cationic surfactants at the 0.001% concentration. (See also W88-04894) (Author's abstract)
W88-04931

MATHEMATICAL MODEL OF THE SECONDARY RECOVERY PROCESS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
B. J. Claborn.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 543-549.

Descriptors: *Mathematical models, *Groundwater management, *Air injection, *Capillary water, *Groundwater potential, *Groundwater mining, Soil water, Interstitial water, Permeability, Vadose water, Model studies, Groundwater movement, Algorithms, Aquifers.

The relationships usually assumed to apply in the portion of an aquifer bounded by its impermeable base, some essentially horizontal plane above the water table at which it may be assumed that pressures are atmospheric, and a circular cylindrical surface centered at the air-intake well and having a radius sufficiently large to be unaffected by the pressure of the injected air are examined and analyzed. Closed-form solutions for the equations do not exist even for very simple boundary conditions. Moreover, the classical equations fail to represent the physical processes inherent in the use of compressed air to drive vadose water to the water table in several important respects. A modified equation which provides for the drag and pressure forces normally neglected is proposed. Its use should permit the analysis of the water content-permeability relationship when both air and water are moving simultaneously. (See also W88-04894) (Author's abstract)
W88-04932

TECHNICAL LITERATURE ON SECONDARY RECOVERY OF GROUNDWATER AND PETROLEUM,
Texas Tech Univ., Lubbock. Water Resources Center.
G. A. Whetstone.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 550-557.

Descriptors: *Literature review, *Groundwater mining, *Groundwater potential, *Water supply development, *Groundwater movement, Aquifers, Interstitial water, Capillary water, Soil water, Groundwater management, Fluid mechanics, Oil recovery.

In conjunction with the High Plains Underground Water Conservation District-Texas Tech University Water Resources Center project for obtaining water from the Ogallala Formation by secondary recovery, a comprehensive search was made of the literature of secondary recovery of both groundwater and petroleum. The information most useful for a pioneering venture in secondary recovery of water proved to be the literature, particularly that of the period 1917-1950, devoted to the production of oil by air- or gas-drives. Normal petroleum production occurs under an intrinsic gas-drive since petroleum in an undisturbed reservoir consists of oil accompanied by dissolved natural gas which flows under the pressure differences induced when a well is completed into the reservoir. In contrast with the portion of an aquifer below the water table in which all pores are essentially fully saturated by liquid water, the pores in a petroleum reservoir contain oil, often some water, and gas. They are thus not fully saturated by liquids and consequently are physically similar to the vadose zone of an aquifer. The existing literature, including the Selected Water Resources Abstracts (1968-1982), Petroleum abstracts(1961-), several earlier petroleum bibliographies (1937, 1938, 1944, 1957-1959, 1964), and the four-volume series: Secondary Recovery of Oil in the United States (American Petroleum Institute, 1942-1950) are cited and evaluated. (See also W88-04894) (Author's abstract)
W88-04933

APPLICABILITY OF THEORETICAL EXPRESSIONS FOR FLOW RATE INTO PERFORATED DRAINTUBES,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
U. S. Panu.
Nordic Hydrology NOHYBB, Vol 18, No. 3, p 167-184, 1987. 6 fig, 3 tab, 9 ref, append.

Descriptors: *Drains, *Subsoil drains, *Flow rates, *Pipe flow, *Subsurface drainage, *Perforated drains, Soil water, Mathematical equations, Mathematical studies, Drainage, Water table, Flow discharge.

An assessment of the existing theoretical expressions of flow into perforated draintubes was made with regard to their applicability in the estimation of flow rate into perforated drains under field conditions. Experiments were carried out in a physical model which was suitable for the simulation of a steady state ponded water table, as well as for the simulation of curved water table conditions which consisted of a sand tank, end-water reservoirs, constant-head tank, outflow-control device, draintubes, and measuring devices. Experimental results showed the pronounced effect of radial location of circular perforations on flow rate from smooth draintubes; the effect is not adequately described in previously derived theoretical expressions. A method based on the experimental results is proposed for extending the application of existing expressions to curved water table conditions. (Wood-PTT)
W88-05046

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF HYDROLOGICAL FACTORS ON RIVER SUSPENDED SOLIDS CONTAMINATION FROM A COLLIERY IN SOUTH WALES,
University Coll. of Swansea (Wales). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W88-04572

EFFECTS OF WILDFIRE AND LOGGING ON STREAMWATER CHEMISTRY AND CATION EXPORTS OF SMALL FORESTED CATCHMENTS IN SOUTHEASTERN NEW SOUTH WALES, AUSTRALIA,
Forestry Commission of New South Wales, Beecroft (Australia).
S. M. Mackay, and G. Robinson.
Hydrological Processes HYPRE3, Vol. 1, No. 4, p 359-384, November 1987. 9 fig, 11 tab, 14 ref.

Descriptors: *Environmental effects, *Logging, *Forest fires, *Australia, *Water quality, Cations, Chemical analysis, Water analysis, Calcium, Potassium, Magnesium, Sodium, Chlorine, Nitrates, Hydrogen ion concentration, Forest hydrology.

In January 1979, four experimental catchments in forests of southeastern New South Wales were burned by wildfire. Logging before the fire had no detectable effect on concentrations of Ca, K, Mg, Na, Cl, NO3, nor on pH of stream waters. In all burned catchments mean K concentrations increased by from 20% to 60% for a 12 month period and nitrate concentrations increased by factors of about ten in severely burned catchments. In one of the catchments (unlogged) Ca also increased. From one to four years after the fire, concentrations of all ions were either close to or less than levels predicted from the control but, during the fifth and sixth years, concentrations of Mg and Na were higher by 20% to 60%. In all burned catchments, cation exports increased considerably during the first three years after the fire, but major components of these increases were elevated levels of runoff. Exports of Mg and Na were higher than those of the control during the fifth and sixth years after the fire, although runoff had returned to pre-fire levels in the two unlogged catchments and was 10% to 20% greater than the control in the two logged catchments. During this final period, increased ion concentrations were the main factors contributing to the elevated exports. Post-fire logging in one catchment had no detectable effects on streamwater parameters measured in the study but was associated with a further increase in runoff. (Author's abstract)
W88-04574

ALTERNATIVE BASIN CHARACTERISTIC FOR ESTIMATING IMPERVIOUS AREA AND URBAN FLOOD FREQUENCY AND ITS POTENTIAL APPLICATION IN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
R. E. Southard.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 69-72, 3 fig, 1 tab, 4 ref.

Descriptors: *Flood frequency, *Mississippi, *Urban runoff, *Urban hydrology, *Impervious area, Urban areas, Streamflow, Urbanization, Estimating, Rainfall-runoff relationships, Statistics.

The urban basin characteristic called percentage of developed area (PDA) was applied to six Mississippi streamflow-gaging stations. Using statistical analyses, percentage of developed area was shown to estimate impervious area without apparent geographical bias. Flood-frequency relations also indicated that percentage of developed area is a potentially important basin characteristic. The percentage of developed area proved to be as statistically significant as percentage of impervious area in Mississippi. The PDA is considered to be an accurate indicator of urbanization in a basin and has potential application to streams in Mississippi. (See also W88-04665) (Lantz-PTT)
W88-04678

EFFECTS OF GEOLOGY, RUNOFF, AND LAND USE ON THE STABILITY OF THE WEST GALLATIN RIVER SYSTEM, GALLATIN COUNTY, MONTANA,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2E.
W88-04700

MANAGING LANDSCAPES FOR HUMANITY AND NATURE: THE ROLE OF WETLANDS IN REGIONAL NUTRIENT DYNAMICS,
Florida Univ., Gainesville. Center for Wetlands.
For primary bibliographic entry see Field 6G.
W88-04940

IMPACT OF AGRICULTURAL DRAINAGE ACTIVITIES IN THE COASTAL FLATS REGION OF THE CHESAPEAKE BAY,
Fish and Wildlife Service, Annapolis, MD.
For primary bibliographic entry see Field 6G.
W88-04952

FORESTRY AND FOREST MANAGEMENT IMPACTS ON WETLANDS,
Southeastern Forest Experiment Station, Charleston, SC.
W. H. McKee.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 216-224, 3 fig, 9 ref.

Descriptors: *Forestry, *Forest management, *Wetlands, *Environmental effects, Logging, Site preparation, Burning, Environmental policy, Water quality, Runoff, Ecological effects, Bogs, Wildlife habitats.

Forested wetlands, a valuable source of timber, need to be harvested through proper management techniques to avoid sedimentation and nutrient enrichment of runoff and the deterioration of the soils and drainage patterns. Management practices that utilize a shelterwood cut, prescribed burning, site preparation, phosphorus fertilization or hazard indices of probability of damage during the wet season will minimize such problems. In areas where soils have been compacted and drainage impaired, site restoration through destruction and bedding and stand regeneration are the proper remedy. While most wetland forests can be logged using proper management, some are better left alone to avoid destruction of wildlife habitat, impairment of water quality, and reduction of flood protection capacity. (See also W88-04934) (Lantz-PTT)
W88-04954

MINIMIZING ADVERSE IMPACTS ON WETLANDS OF WATER QUALITY ASSOCIATED WITH FOREST AND AGRICULTURAL PRACTICES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5G.
W88-04955

IMPACT OF URBANIZATION ON WATER-COURSES IN WASHINGTON, D.C.,
District of Columbia Dept. of Consumer and Regulatory Affairs, Washington.
J. R. Collier.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 240-245.

Descriptors: *Environmental effects, *Urbanization, *District of Columbia, *Resources management, Wetlands, Potomac River, Anacostia River, Erosion control, Fish migration, Channeling, Management planning, Sedimentation, Urban hydrology, Urban planning.

The change in the last 200 years in the Washington Metropolitan area from an agricultural community to an urban area has resulted in the destruction or elimination of almost all of the formerly extensive wetlands of the Potomac and Anacostia Rivers. Only in the past few years have efforts been made to protect these wetlands from sewage discharge, drainage basin elimination and modification, channelization, and obstructions. While some improvements can be made in Washington, D.C., the primary goal must be to learn from history and avoid repetition of past mistakes. The EPA Chesapeake Bay Plan projects that by the year 2000 the population of the Chesapeake Bay drainage basin will have increased by 15%. Half of these 2 million people will live below the fall line. Prior planning is the only mechanism for protecting the resources that remain. Such planning should identify critical streams and provide for the overall management of land use in the stream basin. Three factors appear to be critical: controlling erosion and sedimentation, maintaining a high percent of pervious area to maintain the hydrograph, and controlling flood plain development to avoid a public outcry for channelization. An additional component needed to protect urban streams is to modify dredge and fill permit regulations covering such activities as culverts and sewers. The regulations should require the modification of any structure which later becomes an obstruction, so that fish migration is not impeded. Future maintenance of channelized streams should incorporate a base flow channel to decrease the width and increase the depth of flow. (See also W88-04934) (Lantz-PTT)
W88-04958

URBANIZATION, WATER QUALITY AND STORMWATER MANAGEMENT - A MARYLAND PERSPECTIVE,
Maryland Water Resources Administration, Annapolis.
For primary bibliographic entry see Field 5G.
W88-04959

RADIOACTIVITY IN HOCKING RIVER BASIN,
Ohio Univ., Athens.
For primary bibliographic entry see Field 5B.
W88-04990

FACTORS CONTROLLING URANIUM AND RADIUM ISOTOPIC DISTRIBUTIONS IN GROUNDWATERS OF THE WEST-CENTRAL FLORIDA PHOSPHATE DISTRICT,
For primary bibliographic entry see Field 5B.
W88-04991

4D. Watershed Protection

MUDDY CREEK GRADE CONTROL STRUCTURES, MUDDY CREEK, MISSISSIPPI AND TENNESSEE,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
C. H. Tate.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 63-67, 7 fig, 2 tab, 2 ref.

Descriptors: *Muddy Creek, *Mississippi, *Tennessee, *Control systems, *Erosion control, *Flow separation, Streamflow, Scour, Erosion, Model studies, Hydraulic structures, Grading, Baffles, Piers, Flow profiles, Streams, Uniform flow.

Muddy Creek flows generally north from Ripley, Mississippi, to the Hatchie River just north of the Mississippi-Tennessee State line. Between September 1976 and September 1983, the Soil Conservation Service (SCS) modified the Muddy Creek system by constructing a trapezoidal channel with 12 riprap grade control structures spaced along the main channel. Flow separation with resultant flow concentration in the exit transitions was determined to be the reason for scour downstream of the grade control structures along the creek. The flow separation is the result of the exit flaring too abruptly for the flow to follow the side slopes. Eddies are formed on both sides of the exit channel, forcing additional flow concentration in the center of the exit channel with resulting higher velocities along the bottom of the channel. Tests were conducted to determine what modifications were required to these existing grade control structures that have 1 on 4 and 1 on 8 exit flares to reduce or eliminate significant scour problems previously observed at these structures. Since the exit flares were fixed, different types of modifications involving baffle piers or a hump placed in the exit transition were tested in an attempt to produce a uniform distribution of flow at the end of the grade control structure. A baffle arrangement with the height of the baffle piers being 75% of the design depth was the most effective design in producing a uniform distribution of flow in the exit channel without any significant backwater effect in the grade control structure. For this type of grade control structure without the use of baffles, flow separation occurred at the upstream end of the exit transition if the exit flare was greater than a 1 on 12 ratio. Minor irregularities (differential settlement or vegetation) on the side slopes of a 1 on 12 flare caused separation and flow concentration, indicating that this was approximately the critical flare ratio below which incipient flow separation occurs. Additional tests indicated that the 1 on 16 exit flare was the maximum that provided satisfactory flow conditions without being sensitive to minor irregularities on the side slopes, and therefore was the recommended design. (See also W88-04665) (Lantz-PTT)
W88-04677

DEVELOPMENT OF DYNAMIC NON-HORTONIAN WATERSHED MODELS FOR STEEPLY SLOPING FORESTED WATERSHEDS: APPLICATION TO EASTERN KENTUCKY,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 4A.
W88-04744

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

REPRESENTATIVE SAMPLING OF GROUND WATER FROM SHORT-SCREENED BOREHOLES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 7B.
W88-04492

TITANIUM AS POLLUTANT AND A NEW METHOD FOR ITS SPECTROPHOTOMETRIC AND ATOMIC ABSORPTION SPECTROMETRIC MICRODETERMINATION WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID,
Center for Water Resources Development Management, Kerala (India).
S. A. Abbasi.
Analytical Letters ANALBP, Vol. 20, No. 11, p 1697-1717, November 1987. 4 fig, 4 tab, 27 ref.

Descriptors: *Titanium, *Spectrophotometry, *Pollutant identification, Chemical analysis, Microdetermination, Atomic absorption spectrophotometry.

The status of titanium as an environmental pollutant is reviewed. A new method suitable for the microdetermination of the metals in plants, animal tissues and waters is based on extractive separation of titanium as its chelate with N-p-methoxyphenyl-2-furylacrylohydroxamic acid (MFHA) in chloroform or isoamyl alcohol and subsequent spectrophotometric or atomic absorption spectrometric determination. How MFHA was chosen from nine new hydroxamic acids is detailed. The overall sensitivity of the spectrophotometric method with chloroform as extracting solvent is better than 1 ppb (0.001 ppm). For atomic absorption spectrometric determination isoamyl alcohol is used as extracting solvent and a sensitivity of 0.2 ppm, which is ten times better than attained earlier, is achieved. There was excellent agreement between the results obtained by the two different instrument methods. (Author's abstract)
W88-04528

LIQUID-LIQUID EXTRACTION AND HIGHER ORDER DERIVATIVE SPECTROPHOTOMETRIC DETERMINATION OF COBALT WITH 1,10-PHENANTHROLINE AND ROSE BENGAL,
Council of Scientific and Industrial Research, Trivandrum (India). Regional Research Lab.
T. Jyothi, M. L. P. Reddy, T. Prasada Rao, and A. D. Damodaran.
Analytical Letters ANALBP, Vol. 20, No. 11, p 1729-1749, November 1987. 4 fig, 8 tab, 15 ref.

Descriptors: *Pollutant identification, *Cobalt, *Spectrophotometry, Rose bengal, Chemical analysis, Phenanthroline, Sea water, Great Salt Lake.

Higher order derivative techniques are mainly used in deconvoluting the overlapping absorption spectra of various analytes in their determination. The procedure utilizing higher order derivatives in molecular absorption spectrophotometry essentially are based on the formation of binary complex viz. metal reacting with a chromogenic reagent. A fourth order derivative spectrophotometric procedure is reported here, for the determination of traces of cobalt based on the liquid-liquid extraction of ternary ion - association complex - cobalt, 1,10-phenanthroline, rose bengal into chloroform. The results of the analysis of synthetic sample solutions of cobalt, with various matrices after overcoming the influence of interferents are described, and show that the method can be used in the trace determination of cobalt in real samples such as sea water and rare earth oxides. In samples of sea water (1,05% Na, 0.04% K, 0.13% Mg, 0.04% Ca and 1.89% Cl) and Great Salt Lake water (6.7% Na, 0.34% K, 0.56% Mg, 0.03% Ca and 11.2% Cl), cobalt was 4.00 micrograms. (Lantz-PTT)
W88-04529

DETERMINATION OF URANIUM IN ENVIRONMENTAL SAMPLES USING INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY,
Ontario Ministry of the Environment, Rexdale.
D. W. Boomer, and M. J. Powell.
Analytical Chemistry ANCHAM, Vol. 59, No. 23, p 2810-2813, December 1, 1987. 5 fig, 4 tab, 14 ref.

Descriptors: *Pollutant identification, *Uranium, *Mass spectrometry, Chemical analysis, Water quality, Drinking water.

The maximum allowable concentration for uranium as set in the Ontario Drinking Water Objectives is 20.0 micrograms/L. Studies have shown that concentrations of uranium as low as 500 micrograms/L have been found to affect the reproductive capability of aquatic organisms. There are a number of methods for estimating uranium concentrations in various matrices. The conventional fluorometric method used has a detection limit of 5.0 micrograms/L uranium in environmental sam-

ples. This technique is both slow and subject to interference. An analytical technique using inductively coupled plasma mass spectrometry has been developed to estimate the concentration of uranium in a variety of environment samples. The lower limit for quantitation is 0.1 ng/mL. Calibration is linear from the low limit to 1000 ng/mL. The precision of the method estimated by repeat analyses of NBS (National Bureau of Standards) standards was estimated at 1-3% relative standard deviation within runs and 6% between runs. Accuracy using NBS standards was within 10% except for urban particulate, tomato leaves, and pine needles. (Lantz-PTT)
W88-04545

VOLATILIZATION LOSSES OF ORGANICS DURING GROUND WATER SAMPLING FROM LOW PERMEABILITY MATERIALS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
T. A. McAlary, and J. F. Barker.
Groundwater Monitoring Review GWMRDU, Vol. 7, No. 4, p 63-68, Fall 1987. 4 fig, 10 ref. Lottery Trust Fund Project No. 148PL.

Descriptors: *Volatilization, *Organic compounds, *Groundwater quality, *Water sampling, *Pollutant identification, Water quality, Monitoring, Chlorinated hydrocarbons, Permeability.

Volatilization biases that can affect a groundwater samples before its collection from a monitoring well were evaluated.In low permeability materials, groundwater normally must accumulate for hours to days after flushing before a volume sufficient for sampling is available. During this period, the groundwater sample is open to the atmosphere and volatilization can lower the concentration of volatile compounds in solution. Laboratory simulations were conducted to evaluate this bias using four chlorinated, one- and two-carbon compounds. Two distinct conditions of headspace exposure were investigated: (a) the water standing in the well casing, and (b) formation water entering the screen of a well that has been dewatered during purging. Water standing in the well was depleted in volatile organics by exponential decay with a half life of about four days. Volatilization losses will be less than 10% if the standing time is less than about six hours. In wells that have been purged dry, volatilization losses of 10% are likely in as little as five minutes as the recovering formation water trickles through the headspace in the dewatered sand filter pack. Losses may reach 70% for recovery periods of one hour. When the sand filter pack is drained by the purging procedure, the sample should not be analyzed for volatile constituents since volatilization biases are likely to be substantial. Conventional open system monitoring wells should be used to collect volatile organic samples only if fresh formation water can be drawn into the well with minimal turbulence and exposure to the atmosphere. One should therefore avoid drawing the water level down into the sand pack when the well is purged. Specialized sampling methods should be developed and evaluated for volatile organics where sample integrity is critical. (Author's abstract)
W88-04547

IN SITU MULTILEVEL SAMPLER FOR PREVENTIVE MONITORING AND STUDY OF HYDROCHEMICAL PROFILES IN AQUIFERS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
D. Ronen, M. Magaritz, and I. Levy.
Groundwater Monitoring Review GWMRDU, Vol. 7, No. 4, p 69-74, Fall 1987.11 fig, 17 ref.

Descriptors: *Sampling, *Aquifers, *Groundwater pollution, *Monitoring, *Multilevel sampler, Chemical analysis, Measuring instruments, Dialysis, Saturated zone, Aeration zone, Groundwater quality, Water quality control, Path of pollutants.

A modular multilevel sampler (MIS) was developed and utilized for sampling undisturbed groundwater chemical profiles and gases in both the saturated and the unsaturated zone. Sampling at 3-cm depth intervals is based on the dialysis-cell method and has no depth limitations. The equilibration time of a dialysis cell system can be calculated using Fick's second law of diffusion, as C=(Co/2)erfc(x/2(DT)to the 1/2 power) where C = concentration, Co = original concentration, D = ionic diffusion coefficient for a specific temperature. Sampling and measuring the actual contaminant fluxes reaching the water table from the unsaturated zone, before they are diluted in groundwater, has several advantages: (1) it increases the detection sensitivity of the monitoring system, as pollutants arriving from the unsaturated zone will be found at maximum concentration in the water table region; (2) it gives ample time (decades) for remedial actions to be undertaken before massive groundwater contamination occurs; and (3) it enables establishment of a quantitative relationship between the amount of pollutant released in the soil and the amount that actually reaches groundwater. The MLS is portable, inexpensive and easy to operate. The dialysis cells are in continuous dynamic equilibrium with the gas and liquid phases in the aquifer. (Lantz-PTT)
W88-04548

FIELD EVALUATION OF WELL PURGING PROCEDURES,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
M. J. L. Robin, and R. W. Gillham.
Groundwater Monitoring Review GWMRDU, Vol. 7, No. 4, p 85-93, Fall 1987. 8 fig, 2 tab, 9 ref.

Descriptors: *Sampling, *Water Well, *Well purging, *Groundwater quality, Field tests, Stagnant water, Geohydrology, Well screens, Water sampling, Well hydraulics, Tracers, Pumping.

In order to avoid contamination of groundwater samples by stagnant water in the well bore, it is generally recommended that the well be purged prior to sampling. There is, however, a divergence of opinion both on the need for purging and the best methods of purging. Described are detailed field tests in which non-reactive tracers were used to examine, from a well hydraulics point of view, the need for purging and also the effectiveness of various purging procedures. Results show that in the permeable geologic materials of the test site, and for the non-reactive tracers, the water within the screened interval will be purged by the natural flow of water through the screen, while the water above will remain stagnant. The volume of water above the screen is referred to here as one bore volume. It is suggested that with consideration of the required sample volume, the volume of water stored in the screen, the sampling rate, and the position of the sampler intake, dedicated samplers could be used to obtain representative groundwater samples without prior purging of the well. Of the purging procedures tested, pumping from just below the air-water interface in the well, or the method of 'complete removal' of the water within the well bore were the only effective means for complete removal of the stagnant water. Using these procedures, it appeared that representative samples could be obtained with the removal of only two to three bore volumes of water. (Author's abstract)
W88-04550

FEASIBILITY STUDIES FOR THE DETECTION OF ORGANIC SURFACE AND SUBSURFACE WATER CONTAMINANTS BY SURFACE-ENHANCED RAMAN SPECTROSCOPY ON SILVER ELECTRODES,
EIC Labs., Inc., Norwood, MA.
M. M. Carrabba, R. B. Edmonds, and R. D. Rauh.
Analytical Chemistry ANCHAM, Vol. 59, No. 21, p 2559-2563, November 1, 1987, 6 fig, 2 tab, 31 ref. DOE Contract No. DE-AC01-86ER80333.

Descriptors: *Pollutant identification, *Organic compounds, *Groundwater pollution, *Raman spectroscopy, Silver electrodes, Spectroscopy, Chemical analysis, Water analysis, Pyridine, Quinoline.

Fundamental components of various families of organic contaminants that are found in surface and subsurface waters have been investigated by surface-enhanced Raman spectroscopy (SERS). The SERS substrate was a silver electrode maintained at various electrode potentials. The SERS spectra were recorded for 14 organic compounds from various families (amines, phenols, nitroaromatics, aromatic N-heterocycle, both basic and neutral; neutral aromatic hydrocarbons) as well as organic solvents and humic acid. Only the quinoline and pyridine spectra are shown in detail. The limit of detection for pyridine was calculated to be 8.5 pg. Variation of the electrode potential and excitation wavelength was used to qualitatively determine a two-component mixture of contaminants. The in situ type of conditions of low ionic strengths and humic materials did not inhibit the SERS effect on the silver electrode. (Lantz-PTT)
W88-04556

TRACE ANALYSIS OF VANADIUM IN ENVIRONMENT AS ITS TERNARY COMPLEX WITH N-P METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND 3-(O-CARBOXYPHENYL)-1-PHENYLTRIAZINE-N-OXIDE,
Centre for Water Resources Development and Management, Kunnamangalam (India).
S. A. Abbasi.
Analytical Letters ANALBP, Vol. 20, No. 9, p 1347-1361, 1987. 2 fig, 4 tab, 28 ref.

Descriptors: *Pollutant identification, *Vanadium, *Chemical analysis, Tissue analysis, Water analysis, Rock properties, Ternary complexes, Chemical reactions.

A method is presented for the highly-sensitive, selective, and rapid determination of V at submicrogram levels in rocks, animal tissues, plant tissues and natural waters. The method is based on the selective extraction of V from strongly acidic (3-8 M hydrochloric acid) medium with solution of N-p-methoxyphenyl-2-furylacrylohydroxamic acid MFHA in chloroform. The reddish-violet extract (molar absorbance 8,600 l/mole/cm at lambda max 545 nm) is then equilibrated with 3-(o-carboxyphenyl)-l-phenyltriazine-N-oxide at about pH 1.5. The resulting ternary complex has enhanced color (molar absorbance 14,000 l/mole/cm at lambda max 450 nm). The ternary system obeys Beer's Law at 450 nm over the range 0-18 micrograms/ml of V. The extraction system achieves 20-fold enrichment of V and enables the determination of the metal down to parts per billion (ng/l) levels. The method tolerates the presence of large number of anions and cations which are normally present with V in rocks, plant tissues, animal tissues and natural waters. The applicability of the method was tested by the analysis of V in these matrices. (Author's abstract)
W88-04557

SIMULTANEOUS DISSOLUTION OF ORGANIC ACIDS IN SEQUENTIAL LEACHING OF SEDIMENT BOUND TRACE METALS,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
S. Karlsson, K. Hakansson, and B. Allard.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 6, p 549-562, 1987. 1 fig, 4 tab, 18 ref.

Descriptors: *Organic acids, *Heavy metals, *Leaching, *Fate of pollutants, *Ion exchange, Path of pollutants, Humic acids, Fulvic acids, Chemical analysis, Copper, Acid mine drainage, Stream pollution, Cadmium, Iron, Manganese, Zinc.

Inorganic metal-solid associations can be characterized somewhat arbitrarily in various extraction procedures. The simultaneous extraction of organics (humic and fulvic acids, HFA, characterized by their UV absorbance) was studied in the sequential leaching of sediment bound trace metals (Cd, Cu, Fe, Mn and Zn). Samples were obtained from a small stream receiving high annual loading of metaliferous and acid (pH about 3) mine effluents. Typically 2-5% of the total HFA would follow the ion exchangeable fraction, 4-10% the carbonate/hydroxide fraction and 7-13% the hydrous oxide fraction. Essentially no HFA remains after wet

oxidation with H2O2/HNO3. From the distribution of the metals and the HFA between the various leaching steps it appears that organics can constitute a significant structural component of the amorphous hydrous oxide phase (iron and manganese) that partly prevents the distribution of this fraction in reducing acidic media (NH2-OH-HCl). (Author's abstract)
W88-04558

FLOW-INJECTION ANALYSIS OF SUBSTANCES IN WATER. PART I. ANIONS. A CRITICAL REVIEW,
Pretoria Univ. (South Africa). Dept. of Chemistry.
J. F. Van Staden.
Water SA, Vol. 13, No. 4, p 197-208, August 1986. 10 tab, 55 ref.

Descriptors: *Water quality control, *Pollutant identification, *Water analysis, *Anions, *Flow-injection analysis, Chemical analysis, Sulfates, Sulfides, Chlorides, Chlorine, Nitrites, Nitrates, Phosphates, Silicates, Cyanides, Alkalinity.

For effective control of water quality, a routine water laboratory should be geared to analyze large numbers of samples rapidly and reliably, making use of proven method of analysis. A critical review of the present status of flow-injection analysis (FIA) of anions in water is given, highlighting the possibilities of FIA methods in this area, such as methods for the determination of sulfate, sulfide, chloride, residual chlorine, nitrite, nitrate, phosphate, silicate, cyanide and alkalinity. (Author's abstract)
W88-04563

OCCURRENCE OF ORGANIC MICRO-POLLUTANTS IN THE VAAL RIVER BETWEEN GROOTDRAAI DAM AND PARYS,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5B.
W88-04564

ASSESSMENT OF WATER QUALITY IN THE INADI WARD, VULINDLELA DISTRICT, KWAZULU,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Crop Science.
For primary bibliographic entry see Field 5F.
W88-04565

QUANTITATIVE ANALYSIS OF LIGNOSULPHONATE USING BENZETHONIUM CHLORIDE - PRELIMINARY INVESTIGATIONS,
Natal Univ., Durban (South Africa). Dept. of Chemical Engineering.
M. Lussi, and F. G. Neytzell-de Wilde.
Water SA, Vol. 13, No. 4, p 225-228, August 1986. 1 fig, 9 tab, 14 ref.

Descriptors: *Pollutant identification, *Lignosulfonate, *Benzethonium chloride, Chemical analysis, Pulp wastes, Pulp and paper industry, Wastewater analysis, Hydrogen ion concentration, Sulfites.

The standard method for the analysis of lignosulfonates in sulfite pulp mill effluents uses 2-naphthylamine as the precipitant. This chemical has been declared a carcinogen and a safer precipitant needed to be found. Hyamine-1622 (benzethonium chloride) is a high molecular mass quaternary ammonium compound normally used as a germicide. The chemical could be used to give consistent results for the determination of lignosulfonate in the effluents from a sulfite pulp mill and in the concentrates and permeates resulting from the ultrafiltration of such effluents. Details of an analytical procedure are presented. Although the initial findings appear promising they should be considered to be preliminary. The optimum ratio of lignin in Hyamine-1622 averaged 1:1.5. If an excess of Hyamine-1622 is added, it tends to suppress the precipitation of Hyamine lignosulfonate. The final volume in the analytical procedure must be constant to achieve consistent results and the pH of the solution under which optimum precipitation occurs is near 2 (but not below 2). Standard deviations for the 2-naphthylamine and Hyamine-1622 methods using spruce lignin were 0.31 and 0.11 respectively for approximately 30 gm/l lignin. The results of analysis of the sulfite pulp mill concentration liquor had a standard deviation of 1.4 (for a concentration of approximately 134 gm/l lignin). In general, the consistent results obtained on different strengths of sulfite liquor imply that the Hyamine-1622 method can be applied to many of the calcium bisulfite process effluents containing lignosulfonate. Results obtained using Hyamine-1622 are approximately 10% lower than those using 2-naphthalamine. If necessary, a small correction factor could be applied to the Hyamine method as is done in the 2-naphthylamine method. (Lantz-PTT)
W88-04566

TECHNIQUE TO DETECT SCHISTOSOME CERCARIAE IN NATURAL WATER THROUGH EXPOSURE OF SENTINEL HAMSTERS,
Blair Research Lab., Harare (Zimbabwe).
S.K. Chandiwana.
Journal of Parasitology, Vol. 73, No. 2, p 452-454, April 1987. 1 fig, 1 tab.

Descriptors: *Parasites, *Hamsters, *Schistosomiasis, *Contamination, Identification, Human diseases, Eggs, Morphology, Electrophoresis.

Detection of the presence of cercariae in natural water is important in the study of transmission of schistosomiasis in this medium. the author measured daily cercarial densities in natural water through exposure of hamsters to the pathogen, comparing starch gel electrophoresis with liver examination in identifying schistosomes to the species level. A cylindrically shaped hamster exposure cage was used, allowing exposure to schistosome cercariae with the animal under water. Hamsters were exposed for 2 hr each day on consecutive or alternate days for a total of 6 hr for a maximum of 1200-1400 hrs. After exposure, animals were kept for 14 weeks to allow cercariae to mature. Results of schistosome identification from the morphology of the eggs embedded in the liver of infected animals corresponded closely to identification by starch gel electrophoresis of adult worms. The hamster exposure technique has an advantage over cercariometric techniques, allowing determination of schistosome species as well as cercarial density. (Friedmann-PTT)
W88-04658

LITERATURE REVIEW OF THE EFFECTS OF PERSISTENT TOXIC SUBSTANCES ON GREAT LAKES BIOTA,
Beak Consultants Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 5C.
W88-04726

CHEMICAL SPECIATION APPROACH TO EVALUATE WATER QUALITY PROBLEMS IN THE BLACKBIRD MINING DISTRICT, IDAHO,
Idaho Univ., Moscow. Dept. of Chemistry.
C. M. Wai, and W. M. Mok.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128111/AS. Price codes: A04 in paper copy, A01 in microfiche. Idaho Water Resource Research Institute, Moscow, Completion Report, October, 1986. 65 p, 18 fig, 11 tab, 23 ref, append. Contract No. 14-08-0001-G1014-04. Project No. USGS G1014-04.

Descriptors: *Idaho, *Sediment contamination, *Leaching, *Arsenic, *Analytical techniques, *Trace metals, *Antimony, *Chemical speciation, *Pollutant identification, Water quality, Blackbird Mining District.

This research studied the effects of the contaminated sediments on the water quality of the creeks surrounding the Blackbird Mining area. Experiments were conducted to evaluate the leaching characteristics of arsenic species, As(III) and As(V), and other trace metals from sediments collected. The major arsenic species leached from the sediments under aerobic condition is As(V). The leaching characteristics of antimony appear to be similar to those of arsenic, except the amount of antimony leached from the sediments is much lower compared with arsenic. Leaching of cobalt, copper, and manganese generally increases with the acidity of the solution. Water samples collected from Panther Creek above the confluence of Blackbird Creek showed very low concentrations of arsenic and other metals. Below the confluence point, higher levels of arsenic, cobalt, and copper were found in creek waters. Water samples collected from Blackbird Creek usually showed lower arsenic compared to those from Panther Creek. A solvent extraction method was developed for the separation of arsenic and antimony species in natural waters using pyrrolidinecarbodithioate (PCDT) as a chelating agent. (Wai-IWWRI)
W88-04737

HYDROSPHERIC TRACE ELEMENTS AND THEIR APPLICATION IN TRACING WATER POLLUTANTS,
Oregon State Univ., Corvallis. Dept. of Chemistry.
W. D. Loveland.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-202180/AS. Price codes: A03 in paper copy, A01 in microfiche. Oregon Water Resources Research Institute, Final Technical Completion Report, Corvallis, June 1983. 24 p, 13 append. Contract No. 14-34-0001-8110. Project No. B-055-ORE (1).

Descriptors: *Radioactive tracers, *Fate of pollutants, *Rare earth elements, Tracers, X-ray fluorescence, Radioactivity techniques, Monitoring, Water pollution sources, Organic compounds, Trace elements, Fluorescence, Pollutant identification, Path of pollutants.

Stable activable tracer technologies using rare earth nuclides with short-lived activation products were developed and tested in both the laboratory and field. These tracers have been applied to the monitoring of pollutant dispersal in fresh water and estuarine systems and to trace toxic organic chemicals in the marine environment. The development, testing and application of stable x-ray fluorescent tracers for small water systems is also described. These non-toxic, cost-competitive tracers are sensitive, are not adsorbed by sediments, and can mark specific pollutants making it possible to trace the effluent from several sources simultaneously. The naturally occurring levels of the tracer metal atoms, particularly the levels of rare earth elements, were found to be quite low in Pacific Northwest streams and lakes. The rare earth elemental concentrations in river water are controlled by the solubilities of rare earth phosphates and by the association of rare earth elements with humic substances. (Geiger-PTT)
W88-04747

MEASUREMENT OF PROTEOLYSIS IN NATURAL WATERS AS AN APPROACH TO THE STUDY OF NATURAL CYCLING AND POLLUTION IMPACT,
Vermont Univ., Burlington. Dept. of Microbiology and Biochemistry.
R. E. Sjogrenm.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-234704/AS. Price codes: A02 in paper copy, A01 in microfiche. Vermont University Burlington, Water Resources Research Center, Completion Report, December 1982. 10 p, 2 fig, 4 tab, 7 ref.

Descriptors: *Pollutant identification, *Proteolysis, *Proteolytic rates, *Phosphorus, Spectrophotometry, Xenobiotic pollutants, Environmental microbiology, Vermont, Lakes, Orthophosphates, Bioassay, Trophic state, Bacteria.

These studies were conducted using a spectrophotometric assay that utilizes a particulate chromogenic protein to detect and follow proteolytic activity of natural mixed bacterial populations from lake water. Seasonal changes in proteolytic rates were found to be related to lake turnover, algal blooms, and are dependent on the dominant pro-

teolytic bacterium. In addition, temperature, but not pH changes lead to changes in proteolytic rates. Addition of 100 micrograms per liter of orthophosphate leads to an increase in proteolytic rates by 54 percent, while the addition of metal cofactors leads to variable increases (about 5 percent) in rates when compared to control flasks. The addition of chemical contaminants (pesticides, herbicides, etc.) generally leads to a reduction in the rate of proteolysis. Toxic heavy metals were also inhibitory with Cu being more inhibitory than Hg > Cd > Pb. Recognition of the sensitivity of this assay to varying levels of added orthophosphate lead to the development of a procedure for assessment of trophic state of freshwater ecosystems. Preliminary data demonstrate a reasonable correlation between biologically available phosphorus and trophic state. (USGS)
W88-04764

CRITICAL ANALYSIS OF FACTORS AFFECTING THE SENSITIVITY OF ZOOPLANKTON AND THE REPRODUCIBILITY OF TOXICITY TEST RESULTS,
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
U. M. Cowgill.
Water Research WATRAG, Vol. 21, No. 12, p 1453-1462, December 1987. 3 fig, 2 tab, 41 ref.

Descriptors: *Bioindicators, *Daphnia, *Nutrient requirements, *Diets, *Toxicity, Bioassay, Zooplankton.

Variables affecting the test sensitivity and reproducibility include: (1) nutrition of test zooplankton, their health and diet; (2) culturing techniques, particulary the effect of the ambient medium on demographic variables and test results; (3) physical and chemical characteristics of the test compound; (4) purity of the test compound; and (5) the variation in results obtained with nominal and measured concentrations of the test compound. Among the critical factors addressed here are dietary cobalamine and selenium levels, poor health of test animals, and the observation that a diet consisting of several algal species results greater tolerance of zooplankton to toxicants than does a diet of synthetic food. Recommendations for improving good precision and low percentage coefficient of variation in 'Round Robin' testing programs are made concerning the health of test animals, purity of test compounds, concentrations of test chemicals, strain-dependent hypersensitivity to particular compounds. (Rochester-PTT)
W88-04845

COLIPHAGES AS AN INDICATOR OF FAECAL POLLUTION IN WATER. ITS RELATIONSHIP WITH INDICATOR AND PATHOGENIC MICROORGANISMS,
Malaga Univ. (Spain). Dept. of Microbiology.
J. J. Borrego, M. A. Morinigo, A. de Vicente, R. Cornax, and P. Romero.
Water Research WATRAG, Vol. 21, No. 12, p 1473-1480, December 1987. 8 fig, 2 tab, 44 ref. Comision Asesora Cientifica y Tecnica del Ministerio de Educacion y Ciencia del Gobierno de Espana Project 1158/81.

Descriptors: *Coliforms, *Wastewater pollution, *Bacteriophage, *Water pollution sources, *Sewage bacteria, *Feces, *Bioindicators, Escherichia coli, Pathogens, Viral analysis, Host-parasite system, Wastewater outfall.

The proposal that Escherichia coli-specific bacteriophages might serve as universal fecal pollution indicators was tested. A highly-specific, sensitive, and rapid technique for the detection and quantification of these virus particles was developed. The numerical relationship between E. coli and its parasitic phages was investigated in three different aqueous ecosystems: seawater near sewage outfalls, river water contaminated by domestic and industrial sewage discharges, and estuarine water. The relationship was close in all habitats. The results indicate also that coliphages are good indicators of the presence of these pathogenic microorganisms. In nearly all the water samples tested, coliphages appear to be better indicators of fecal pollution than the classical indicator systems currently employed. (Author's abstract)
W88-04847

SIMULTANEOUS CONSTRUCTION OF SINGLE-PARAMETER AND MULTIPARAMETER TROPHIC STATE INDICES,
Environmental Research Center of Kanagawa Prefecture, Yokohama (Japan).
For primary bibliographic entry see Field 2H.
W88-04851

COMPARATIVE SURVIVAL AND INJURY OF CANDIDA ALBICANS AND BACTERIAL INDICATOR ORGANISMS IN STREAMS RECEIVING ACID MINE DRAINAGE,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
D. A. DePasquale, C. B. Law, and G. K. Bissonnette.
Water Research WATRAG, Vol. 21, No. 12, p 1525-1530, December 1987. 3 fig, 3 tab, 29 ref.

Descriptors: *Acid mine drainage, *Coliforms, *Candida, *Bioindicators, Sublethal injury, Yeasts, Bacteria, Seasonal variation, Water temperature.

Microbiological studies assessed the survival and injury characteristics of Candida albicans and indicator bacteria in streams impacted by acid mine water (AMW) and organic wastes. Persistence of pure cultures of C. albicans in three AMW-polluted streams was studied in situ using environmental membrane diffusion chambers. Survival of the fungus (at least 3 days in AMW) indicated prolonged tolerance to acid conditions. In contrast, Escherichia coli was killed within several hours of acid stress. Persistence studies also demonstrated that C. Albicans was less sensitive to seasonal water temperature fluctuations than E. coli or Streptococcus faecium. In addition to its prolonged survival, C. albicans incurred minimal sublethal injury, whereas identical conditions of exposure resulted in significant injury to traditional indicator bacteria. The failure of standard microbiological procedures to detect AMW-damaged bacteria compromises the accuracy of public health safety determinations in these waters. C. albicans may represent a potential alternative sanitary indicator for such environments. (Author's abstract)
W88-04854

NEW METHOD FOR THE RAPID MEASUREMENT OF 224RA IN NATURAL WATERS,
South Carolina Univ., Columbia. Dept. of Geology.
Rama, J. F. Todd, J. L. Butts, and W. S. Moore.
Marine Chemistry MRCHBD, Vol. 22, No. 1, p 43-54, November 1987. 5 fig, 2 tab, 25 ref. NSF Grant OCE-8415964.

Descriptors: *Radium radioisotopes, *Radioactivity techniques, Oceanography, Estuaries, Continental shelf, East coast.

224Ra is preconcentrated from water samples by adsorption onto manganese-dioxide-impregnated acrylic fiber (Mn-fiber). The amount of 224Ra adsorbed on the filter is determined by stripping its daughter, 220Rn, directly from the fiber bundle by circulating a stream of air through it and concurrently measuring the 220Rn activity. This method is simple, fast, sensitive, accurate, and inexpensive. The counting system is portable, and is easily adapted for shipboard use in oceanographic investigations. The same equipment also may be used for measuring 228Th and 226Ra. 224Ra activities in water samples collected from the continental shelf and estuarine waters of the eastern United States coast are presented. (Author's abstract)
W88-04879

EVALUATION OF DEVIATION FROM THE LOGNORMAL DISTRIBUTION AMONG SPECIES AS A POLLUTION INDICATOR IN MARINE BENTHIC COMMUNITIES,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
W. G. Nelson.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 113, p 181-106, December 8, 1987. 1 fig, 8 tab, 73 ref.

Descriptors: *Benthos, *Bioindicators, Lognormal distribution, Probability distributions, Probability plot, Log series, Marine sediments, Variation.

Data from an extensive group of marine benthic studies (199 samples) were used to empirically define the conditions under which the probability-plot methodology may apply by determining inherent levels of deviation from the lognormal distribution of species abundance in marine benthic systems. Levels of deviation from the lognormal in unpolluted marine-benthic communities determined with the probability-plot method were about 6% for replicate samples within a station, 29% based on temporal variation at a single station, and 23% based on spatial differences in location of stations, suggesting that a high inherent level of variability may make general application of the probability-plot method difficult. The probability-plot method appears inappropriate for use in intertidal situations or with field or laboratory experimental manipulations of benthic communities. Physical disturbance failed to generate the predicted deviations from the lognormal in some cases. Four proposed indices of disturbance or pollution (Preston's D1 and D2 and Gray's graphical alternative indices) were not suitable as such. No association of either the log series or lognormal distributions with pollution or disturbance status of samples was seen. Extreme caution in the use and interpretation of results based on the probability-plot method is recommended. (Author's abstract)
W88-04893

NATURAL RADIOACTIVITY IN SOME GROUNDWATERS OF THE CANADIAN SHIELD,
Atomic Energy of Canada Ltd., Pinawa (Manitoba).
For primary bibliographic entry see Field 5B.
W88-04987

DETERMINATION OF BULK RADON EMANATION RATES BY HIGH RESOLUTION GAMMA-RAY SPECTROSCOPY,
Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics.
N. M. Davis, R. Hon, and P. Dillon.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 111-129, 6 fig, 2 tab, 25 ref.

Descriptors: *Radon, *Radioisotopes, *Gamma radiation, *Granite, *Spectroscopy, *Geochemistry, *Pollutant identification, Uranium, Particle size, Rocks.

Radon anomalies and their higher-than-1 average occurrences in nature have recently become issues due to the suspected health threat posed by prolonged exposures to radon and to several of its progeny. A new modified technique of gamma-ray spectroscopy was developed to quantitatively determine radon (Rn-222) emanation losses from bulk samples (size range of the order of 1 cu dm) of selected granitic rocks. Accurate determination of radon loss for each bulk sample is obtained by comparing apparent U-238 abundances calculated from activities of radon precursors (Th-234 and Ra-226) with those calculated from radon progeny (Pb-214 and Bi-214). Results show a general trend of decreasing radon loss with increasing particle diameter; rate of decrease vary within and among rock types in an unpredictable way. Results from the Rockville granite (Minnesota) show the greatest percentage radon loss across the whole range of particle fractions. Radon loss from these rocks is on average 2-3 times higher than for equivalent sized particles of the other granites. Such excessive radon losses from the Rockville granite are unexpected for two reasons: (1) preliminary analysis of the rock does not indicate that the bulk of the

uranium (radium) is concentrated on nor at surfaces of these particles; and (2) the average diameter of grains composing the Rockville granite is approximately 1 cm, which is relatively large and should result in small overall surface area of the rock. One criterion for maximizing radon release from solids is to have small particle (and grain) diameters which in turn increase surface area for radon emanation. On this basis, lower radon losses would be expected from the Rockville and Cape Ann (Peabody, Massachusetts) granites, and higher radon losses from the finer-grained samples such as the Milford, Chelmsford, Andover, and/or Concord granite samples (Massachusetts). Rather, it is suggested that some of the scatter (deviation from linearity) observed for larger particle diameters of finer-grained granites might be due to radon diffusion through their larger internal surface areas. (See also W88-04980) (Lantz-PTT)
W88-04988

RADON IN GROUNDWATER OF THE LONG VALLEY CALDERA, CALIFORNIA,
Lawrence Berkeley Lab., CA.
For primary bibliographic entry see Field 5B.
W88-04989

SAMPLING AND ANALYSIS OF DISSOLVED RADON-222 IN SURFACE AND GROUND WATER,
Geological Survey, Denver, CO.
I. C. Yang.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 193-203, 3 fig, 3 tab, 6 ref.

Descriptors: *Water sampling, *Radon, *Fate of pollutants, *Groundwater pollution, *Pollutant identification, Chemical analysis, Sample preparation, Uranium, Spectrometry, Radioactivity, Radioisotopes.

Radon-222 is a radioactive gas known to occur in groundwater. It diffuses throughout a groundwater aquifer, and its concentration can be many orders of magnitude larger than the concentration of radium or uranium. Sampling and measurement of 222-Rn are complicated by the volatility of the gaseous element. Sample collection for determining the concentration of dissolved 222-Rn in surface water is performed best by placing one end of an evacuated bubbler into the water, and then drawing a water sample directly into the main chamber of the bubbler until the bubbler is about 60% full. For collection of groundwater samples, a peristaltic or submersible pump is needed to supply an unaerated water sample through a short flexible tubing connected to one end of the evacuated bubbler, until the main chamber is abut 60% full. Loss of 222-Rn during transportation from the sampling site to the laboratory (within 1 week) was negligible for low-activity samples and was 2 to 3% for high-activity samples. Current methods for the determination of dissolved 222-Rn in water include: (1) gamma spectrometry; (2) direct liquid-scintillation counting; (3) extraction concentration and liquid-scintillation counting; and (4) direct deemanation and alpha-scintillation counting. The direct deemanation and alpha-scintillation counting method described in this study is more sensitive (0.2 pCi/l for a 60 ml sample) and has better precision compared to other methods for most environmental samples. (See also W88-04980) (Lantz-PTT)
W88-04992

IMPROVED METHOD FOR THE SIMULTANEOUS DETERMINATION OF 224-RA, 226-RA AND 228-RA IN WATER, SOILS AND SEDIMENTS,
Argonne National Lab., IL.
H. F. Lucas.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 219-225, 3 tab, 22 ref. DOE Contract No. W-31-109-ENG-38.

Descriptors: *Pollutant identification, *Radium radioisotopes, *Chemical analysis, *Water pollution, *Soil contamination, Sediments, Actinium, Water analysis, Water supply, Resins, Adsorption.

The naturally occurring concentrations of radium (226-Ra and 228-Ra) in public and private water supplies have been of studied for many years. Both general surveys and local studies have established the geographical regions where well waters exceed 3 pCi/l. In general, the 226-Ra level was determined by the emanation method, while the 228-Ra level was determined from the beta activity of the 228-Ac daughter. In a recent review of the methods used a number of approved analytic methods can bear improvement, especially the method for 228-Ra. The purpose of this work was to develop an improved method for the simultaneous determination of 226-Ra and 228-Ra. It was found that the retention of radium on the Radium Selective Complexer is considerably better than on the Dowex 50 cation exchange resin. In fact, the retention on as little as 10 ml of resin was equal to that for 220 ml of Dowex 50. While it is expected that conditions will be found in which the radium retention will be reduced, this should not occur with potable waters. The accuracy and precision of the radium retention were determined by adding varied known amounts of 226-Ra and 228-Ra to 20 l of tap water. In all cases, the amounts found were within normal statistical limits of the amount added. From this study, it was concluded that the accuracy of this method can approach + or - 2% and that the limit of sensitivity is about 0.5 pCi/l for 226-Ra and 228-Ra. (See also W88-04980) (Lantz-PTT)
W88-04994

RADON MEASUREMENT IN STREAMS TO DETERMINE LOCATION AND MAGNITUDE OF GROUND-WATER SEEPAGE,
Geological Survey, Nashville, TN. Water Resources Div.
R. W. Lee, and E. F. Hollyday.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 241-249, 3 fig, 7 ref.

Descriptors: *Groundwater movement, *Radon, Radioisotopes, *Path of pollutants, *Seepage, Fate of pollutants, Surface-groundwater relations, Geohydrology, Flow profiles, Stream flow, Tennessee, Water temperature.

The location and magnitude of groundwater seepage can be determined by measuring the activity of 222-Rn gas in streams. Radon in groundwater may be 2 to 4 orders of magnitude greater activity than in surface water. Thus, groundwater seepage to a stream usually increases 222-Rn in the streamflow. Downstream of groundwater seepage, 222-Rn decreases in the stream as radon escapes to the atmosphere, particularly in turbulent reaches of the stream. The relation between groundwater and surface water flows can be determined by mass balance assuming no other 222-Rn sources and no significant gas loss from the mix of surface water and groundwater at the sampling point. Measurements of 222-Rn in water from a 0.75 mile reach of a small bedrock-channel stream in Middle Tennessee ranged from 32 to 196 disintegrations/minute/liter. A sample of groundwater from an adjacent spring contained 222-Rn activity of 489 disintegrations/min/l. Based on 222-Rn activities down the sampled reach of the stream 36% of flow leaving the reach was groundwater seepage at a point 0.5 mile downstream from the upstream sampling boundary. Measurements of temperature in the water and bed of the stream verified the point location of groundwater seepage. (See also W88-04980) (Author's abstract)
W88-04996

TECHNIQUE FOR THE RAPID EXTRACTION OF RADON-222 FROM WATER SAMPLES AND A CASE STUDY,
University of Southern California, Los Angeles.
W. M. Berelson, D. E. Hammond, and A. D. Eaton.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 271-281, 8 fig, 5 ref.

Descriptors: *Chemical analysis, *Radon, *Water analysis, *Case studies, California, Groundwater pollution, Uranium, Radioactivity, Water sampling, Drinking water.

The first part of this paper describes of an adaptation of previously used techniques for extraction and analysis of dissolved gases to make quick and accurate measurements of radon in water samples. The second part presents some data from a case study of radon measurements made using this technique and other radioactivity measurements (total alpha activity, uranium concentration) made in groundwaters near Los Angeles, California. The rapid measurement technique for radon analysis has been demonstrated to be useful in the analysis of well water samples for this study of the chemistry of a groundwater basin. The procedure was shown to be accurate, reliable and takes a minimum of sample preparation or analytical work. Because the system is portable, it may be used in field areas when logistics prohibit the transport of samples to a laboratory. Results of the screening program for the Chino groundwater basin indicate that radon concentrations are independent of other radiological measurements in this basin. If EPA sets the limit for radon in drinking water below 1000 pCi/l a significant portion of the basin may be out of compliance without treatment. (See also W88-04980) (Lantz-PTT)
W88-04998

RELATION BETWEEN NATURAL RADIONUCLIDE ACTIVITIES AND CHEMICAL CONSTITUENTS IN GROUND WATER IN THE NEWARK BASIN, NEW JERSEY,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 2K.
W88-04999

RADON SURVEY OF THE AMERICAN WATER WORKS SYSTEM,
American Water Works Service Co., Marlton, NJ.
K. L. Dixon, and R. G. Lee.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 311-346, 1 fig, 14 tab, 5 ref.

Descriptors: *Pollutant identification, *Radon, *Groundwater pollution, *Water supply, Monitoring, Groundwater quality, Aquifers, Pumpage, Surface-groundwater relations, Activated carbon, Adsorption, Drinking water, Aeration.

An analytical survey designed to determine the distribution and concentration of radon in more than 370 wells utilized as water supply sources for 49 companies within the American Water Works Company system was conducted in 1986 and 1987. The survey encompassed well supplies located in 15 states across the continental U.S. Selected wells were monitored to assess the variation in radon levels with pumpage. Additionally, samples were collected to assess the removal efficiency of selected water treatment processes, i.e. granulated activated carbon (GAC) adsorption, aeration (packed tower and tray aeration). A limited number of samples were also collected to monitor the fate of radon during storage and transit within distribution systems. Some of the major conclusions drawn from the radon survey include: (1) American System operating companies in the northeastern part of the country experienced the highest levels of radon in their groundwater supplies; (2) The analytical results from the occurrence phase of the radon survey seemed to correlate well with the known geology of the aquifer materials from

which samples of groundwater were drawn; (3) The observed decrease (approximately 18%) in the levels of radon in water stored within a water supply distribution system was attributable largely to volatilization of the gas due to pumping and agitation of the water and ventilation within the storage vessel; (4) Blending of essentially radon-free surface water with radon-laden groundwater results in a blended water radon concentration that is a function of volumetric dilution; (5) During a 5 day pump test, radon levels fluctuated by more than 20% and were at their highest after 2 hours of pumpage; (6) GAC can effectively reduce radon concentrations in drinking water supplies to very low levels, however the time required becomes cost prohibitive; and (7) Aeration is very effective in the removal of radon from drinking water. (See also W88-04980) (Lantz-PTT)
W88-05000

CONNECTICUT RADON STUDY- USING LIMITED WATER SAMPLING AND A STATEWIDE GROUND-BASED GAMMA SURVEY TO HELP GUIDE AN INDOOR AIR TESTING PROGRAM. A PROGRESS REPORT:,
Connecticut Dept. of Environmental Protection, Hartford. Natural Resources Center.
M. A. Thomas.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 347-362, 4 fig, 36 ref.

Descriptors: *Connecticut, *Pollutant identification, *Radon, *Groundwater quality, *Water quality, Gamma radiation, Monitoring, Water pollution sources, Granite, Gneiss, Maps, Geohydrology, Water supply.

The Connecticut Geological Survey within the State Department of Environmental Protection (DEP) is working with the State Department of Health Services (DOHS) investigating the occurrence of radon in Connecticut. In 1985 and 1986, approximately 300 private and public water supply wells from 20 geological areas were tested for radon by the Toxic Hazards and Public Water Supply Sections of DOHS. Highest groundwater radon was 130,240 pCi/l from the Nonewaug Granite, a two-mica granite (range 10,720-130,240 pCi/l). Elevated radon was found in wells within several granitic gneisses: the Glastonbury Gneiss (3070-80,900 pCi/l from the Nonewaug Granite, a two-mica granite (range 10,720-130,240 pCi/l). Elevated radon was found in wells within several granitic gneisses: the Glastonbury Gneiss (3070-80,900 pCi/l), the Canterbury Gneiss (10,010-64,510 pCi/l), and the Hope Valley Alaskite Gneiss (4060-59,180 pCi/l). These Paleozoic and PreCambrian age rocks underlie about 5% of the state. Intermediate radon levels were found in water from PreCambrian and Paleozoic age stratified metamorphic rocks where radon levels > 10,000 pCi/l were widely scattered in these surveys. Relatively low groundwater radon values were found in central Connecticut Mesozoic age sedimentary rock wells (390-8490 pCi/l) and in Paleozoic age carbonate rock wells (200-4130 pCi/l). Preliminary results from the ground (automobile-borne) gamma radiation survey generally show a positive correlation with radon water analyses, enabling characterization of geological areas in Connecticut as radiation sources. DOHS is currently conducting 2,200 air tests in homes located in geologic areas selected from water analyses and the ground survey. All data is compiled on 1:24,000 maps to be included in multiple natural resource spatial analyses using an automated Geographic Information System. The analyses will explore relations between the distribution of radon levels and earth materials to better define the geologic areas and possible origins of radon in groundwater and in indoor air. (See also W88-04980) (Author's abstract)
W88-05001

RADIUM-228 AND RADIUM-226 IN GROUND WATER OF THE CHICKIES FORMATION, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Malvern, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-05006

PREDICTIVE MODEL FOR INDOOR RADON OCCURRENCES -- A FIRST APPROXIMATION,
For primary bibliographic entry see Field 5B.
W88-05008

OCCURRENCE AND TREATMENT OF URANIUM IN POINT OF USE SYSTEMS IN COLORADO,
EDC, Inc., Lakewood, CO.
For primary bibliographic entry see Field 5F.
W88-05012

TOTAL CARBOHYDRATE: ORGANIC CARBON RATIO AS AN INDICATOR OF SEWAGE-DERIVED ORGANIC MATTER IN BURBO BIGHT SEDIMENTS, LIVERPOOL BAY, UK,
Lancaster Univ. (England). Lancashire and Western Sea Fisheries Joint Committee.
C. M. G. Vivian.
Environmental Pollution EPEBD7, Vol. 46, No. 2, p 105-118, 1987. 2 fig, 2 tab, 25 ref.

Descriptors: *Pollutant identification, *Water pollution sources, *Estuaries, *Carbohydrates, *Organic carbon, *Organic matter, Burbo Bight, Liverpool Bay, Wastewater pollution, Sediments, Marine sediments, Bays, Sludge disposal, Mersey Estuary.

Sediments from the Burbo Bight, Liverpool Bay, were analyzed for their total carbohydrate (TCH) and organic carbon (TOC) contents, and the TCH:TOC ratio (when the TCH is expressed as a percentage of the TOC) was used to give an indication of the amount of sewage-derived organic matter in the sediments. The %TCH values found ranged from 17 to 68 with an average of 40, indicating that sewage-derived organic matter constituted a significant fraction of the organic matter in the sediment. This appears likely t[illegible]ave been derived mainly from the Mersey Estuar[illegible] outflow and the sewage sludge dumped in Liver[illegible]ol Bay, but these two sources cannot be dis[illegible]guished using this technique. It is suggested that further studies are required on the carbohydrates in sewage sludge and coastal sediments to satisfactorily establish this technique. (Author's abstract)
W88-05070

STUDY OF THE EXTRACTION CONDITIONS OF SEDIMENTARY HUMIC ACIDS TO ESTIMATE THEIR TRUE IN SITU SULFUR CONTENT,
British Columbia Univ., Vancouver. Dept. of Oceanography.
R. Francois.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 964-972, July 1987. 3 fig, 7 tab, 27 ref.

Descriptors: *Sulfur, *Humic acids, Anaerobic conditions, Marine sediments.

A procedure is described that prevents artificially raising the S content of anoxic marine sediments. Sediment samples are freeze-dried immediately after their extrusion under a nitrogen atmosphere aboard ship. Humic substances are extracted by 0.5 N NaOH after removal of elemental S from the dried sediment using benzene, which also removes lipid materials. Humic acids are precipitated from the alkaline solutions by acidification to pH 2 with HCl. The formation of elemental S by the oxidation of H2S produced by decomposition of coextracted acid-volatile sulfides is minimized by precipitating under a vigorous stream of nitrogen. Precipitates are freeze-dried and their elemental composition determined. Subsequently, samples are treated with a freshly-prepared CrCl2 solution and the amount of H2S produced is measured to estimate the S contribution of coextracted pyrite and greigite. (Author's abstract)
W88-05106

FLUOROCHROME-STAINING TECHNIQUE FOR COUNTING BACTERIA IN SALINE, ORGANICALLY ENRICHED, ALKALINE LAKES,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. W. Harvey.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 993-995, July 1987. 1 fig, 2 tab, 11 ref.

Descriptors: *Bacterial analysis, *Organic matter, Meromictic lakes, Hydrogen ion concentration, Alkaline water, Dyes, Microscopy.

Epifluorescence direct counting of planktonic bacteria was conducted at Big Soda Lake, Nevada, and Mono Lake, California. To preclude precipitation and staining of dissolved organic material (DOM), the procedure involved isotonic dilution of unfixed samples at in situ pH and filtration before fluorochrome staining. Fluorochrome-DOM complexes remaining on the filter were removed by sequential rinses with isotonic 0.1 M citrate (pH 6.6). With the modified procedure, acridine orange (AO) yielded better specimen-background contrast than did ethidium bromide, Hoechst dye No. 33258, or 4-6-diamidino-2-phenylindole. A modified AO epifluorescence technique worked well for samples from the three chemically distinct zones of Big Soda Lake and from Mono Lake. Both lakes are hypersaline, alkaline, and organically enriched. (Author's abstract)
W88-05107

5B. Sources Of Pollution

HYDROGEOLOGY OF AN ALKALINE FLY ASH LANDFILL IN EASTERN IOWA,
Illinois State Water Survey Div., Champaign. Meteorology Section.
L. Le Seur Spencer, and L. D. Drake.
Ground Water GRWAAR, Vol. 25, No. 5, p 519-526, September-October 1987. 7 fig, 4 tab, 26 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Geohydrology, *Fly ash, *Landfills, *Groundwater movement, *Iowa, *Leachates, Chemical properties, Monitoring, Hydrogen ion concentration, Water level, Alkalinity, Calcium, Magnesium, Sodium, Potassium, Chlorides, Arsenic, Selenium.

The hydrogeology and chemical quality of the shallow groundwater regime at a coal fly ash landfill was investigated near Montpelier, Iowa. An embankment dam retains the two-hectare deposit of silt-sized alkaline coal fly ash in an upland ravine. The fly ash landfill was operated between 1964-1973 and was subsequently capped with a thin loess layer and seeded to pasture. The ash is underlain by loess, over clay-rich till, over sandstone. Groundwater now saturates the lower one-half of the ash. Nineteen shallow monitoring wells were installed around and within the landfill. Sampling in 1983-1984 was conducted for water levels, temperature, pH, alkalinity, specific conductance, calcium (Ca 2+), magnesium (Mg 2+), sodium (Na+), potassium (K+), sulfate (SO4 2-), chloride (Cl-), arsenic (As), and selenium (Se). Calculated ion balances for 30 analyses had an error of less than 4%. Native loess-derived groundwater of a calcium bicarbonate type enters the landfill, and then shifts to a calcium sulfate type. A distinct leachate plume presently extends at least 46 m downgradient from the landfill, passing under and through the dam, then discharging into a small pond. SO4(2-) and Se concentrations in the plume exceed EPA drinking water standards, and trace As was detected. Although groundwater pH increased after entering the landfill, bicarbonate alkalinity declined. Results of equilibrium solubility calculations suggest that this condition evolved from calcite supersaturation within the landfill, precipitating calcium carbonate. Dissolution of calcium and magnesium oxides on the glassy fly ash spheres sustains the highly alkaline leachate strength. (Author's abstract)
W88-04485

GROUND-WATER CONTAMINATION NEAR A URANIUM TAILINGS DISPOSAL SITE IN COLORADO,
Nuclear Regulatory Commission, Washington, DC.
D. J. Goode, and R. J. Wilder.
Ground Water GRWAAR, Vol. 25, No. 5, p 545-554, September-October 1987. 14 fig, 1 tab, 18 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Uranium, *Radioactive wastes, *Waste disposal, *Colorado, *Mine wastes, Path of pollutants, Molybdenum, Groundwater movement, Seasonal variation.

Contaminants from uranium tailings disposed of at an active mill in Colorado have seeped into the shallow groundwater onsite. This groundwater discharges into the Arkansas River Valley through a superposed stream channel cut in the resistant sandstone ridge at the edge of a synclinal basin. In the river valley, seasonal surface-water irrigation has a significant impact on hydrodynamics. Water levels in residential wells fluctuate up to 20 ft and concentrations of uranium, molybdenum, and other contaminants also vary seasonally, with highest concentrations in the Spring, prior to irrigation, and lowest concentrations in the Fall. Results of a simple transient mixing cell model support the hypothesis that lateral groundwater inflow, and not irrigation recharge, is the source of groundwater contamination. (Author's abstract)
W88-04488

STATISTICAL MODELS FOR THE ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN WASTE DISPOSAL SITES,
Illinois State Psychiatric Inst., Chicago.
R. D. Gibbons.
Ground Water GRWAAR, Vol. 25, No. 5, p 572-580, September-October 1987. 4 tab, 20 ref.

Descriptors: *Path of pollutants, *landfills, *Waste dumps, *Statistical models, *Organic compounds, *Volatile organics, *Fate of pollutants, Waste disposal, Disposal sites, Poisson ratio, Mathematical studies.

The occurrence of low-level hits of volatile organic priority pollutant compounds is statistically modeled as a Poisson process. Methods are developed to estimate the mean of the Poisson distribution for a random sample of volatile organic measurements as well as 99% prediction limits and 99% tolerance limits. The prediction limits provide an interval estimate that will include values obtained for the next K future measurements based on a sample of n previous measurements with 99% confidence. The tolerance limits provide an interval estimate for the n previous measurements that will contain 99% of the population of background measurements with 95% confidence. These methods are illustrated with measurements obtained from 61 field blanks, 56 trip blanks, and 162 samples obtained from 29 upgradient wells. Both prediction and tolerance limits yielded extremely similar results in all three examples. (Author's abstract)
W88-04491

THREE-DIMENSIONAL ANALYTICAL METHOD FOR PREDICTING LEACHATE MIGRATION,
HydroGeologic, Inc., Herndon, VA.
P. S. Huyakorn, M. J. Ungs, L. A. Mulkey, and E. A. Sudicky.
Ground Water GRWAAR, Vol. 25, No. 5, p 588-598, September-October 1987. 10 fig, 19 ref.

Descriptors: *Path of pollutants, *Leachates, *Mathematical analysis, *Mathematical models, Gaussian distribution, Hydrodynamics, Adsorption, Model studies, Fate of pollutants.

An analytical model for predicting contaminant transport from a Gaussian vertical strip source in a three-dimensional uniform groundwater flow field, takes account of hydrodynamic dispersion, adsorption, and decay. The effects of partial penetration of the contaminant source and finite aquifer thickness are accounted for. Dimensional analysis and type curve procedure were developed for evaluating steady-state (or maximum attainable) concentration along the plume center line. Application of the type curve procedure was demonstrated. Also included in the presentation is a method for evaluating the effective decay constant of a nonconservative chemical, based on an assumption of simple hydrolysis. The proposed model has been compared with three other analytical models given in he literature. Two simulation examples are presented. The model has certain advantages in that its formulation accounts for the three-dimensional dispersion, and the effect of partial penetration of a contaminant source in the finite thickness aquifer. (Lantz-PTT)
W88-04493

QUALITY GROUNDWATER FOR TOMORROW,
Miljoestyrelsen, Copenhagen (Denmark).
For primary bibliographic entry see Field 5G.
W88-04513

TITANIUM AS POLLUTANT AND A NEW METHOD FOR ITS SPECTROPHOTOMETRIC AND ATOMIC ABSORPTION SPECTROMETRIC MICRODETERMINATION WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID,
Center for Water Resources Development Management, Kerala (India).
For primary bibliographic entry see Field 5A.
W88-04528

SOURCES OF GROUND WATER SALINIZATION IN PARTS OF WEST TEXAS,
Texas Univ. at Austin. Bureau of Economic Geology.
B. C. Richter, and C. W. Kreitler.
Groundwater Monitoring Review GWMRDU, Vol. 7, No. 4, p 75-84, Fall 1987. 5 fig, 2 tab, 13 ref. Railroad Commission of Texas Contract No. IAC(84-85)-2122.

Descriptors: *Water pollution sources, *Salinization, *Groundwater pollution, *Texas, Aquifers, Chemical analysis, Groundwater quality, Nitrates, Salinity, Sulfates, Bromides, Nitrites, Chlorides, Brine, Leaching.

Determination of chemical constituent ratios allows distinction between two salinization mechanisms responsible for shallow saline groundwater and vegetative-kill areas in parts of west Texas. Mixing of deep-basin (high Cl) salt water and shallow (low Cl) groundwater results in saline waters with relatively low Ca/Cl, Mg/Cl, SO4/Cl, Br/Cl, and NO3/Cl ratios. Scattergrams of major chemical constituents vs. chloride of these waters indicate trends with deep-basin brines as high Cl end members. Evaporation of groundwater from a shallow water table, in contrast, results in saline water that has relatively high Ca/Cl, Mg/Cl, SO4/Cl, and Br/Cl ratios. Trends indicated by plots of this water type do not coincide with trends indicated by plots of sampled brines. Leaching of soil nitrate in areas with a shallow water table accounts for high NO3 concentrations in shallow groundwater. (Author's abstract)
W88-04549

COMPARISON OF GROUND WATER MONITORING DATA FROM CERCLA AND RCRA SITES,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV. Environmental Chemistry Dept.
For primary bibliographic entry see Field 7C.
W88-04551

SIMULTANEOUS DISSOLUTION OF ORGANIC ACIDS IN SEQUENTIAL LEACHING OF SEDIMENT BOUND TRACE METALS,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 5A.
W88-04558

POLYCHLORINATED BIPHENYL-TRANSPORT RATES IN THE UPPER HUDSON RIVER, NEW YORK, 1977-83,
Geological Survey, Albany, NY.
C. R. Barnes.
Northeastern Environmental Science NOESDE, Vol. 6, No. 1, p 31-36, 1987. 6 fig, 1 tab, 14 ref.

Descriptors: *Fate of pollutants, *Polychlorinated biphenyls, *Hudson River, Suspended sediments, New York, Water pollution sources, Sediment transport, Estuaries, Solute transport, Scour.

After the cessation of point discharges of PCBs (polychlorinated biphenyls) in 1977, an estimated 165,000 kg of PCBs remain in the riverbed and riverbanks of the upper Hudson River and continue to be released to the water column. The PCB-transport rate from the upper river to the estuary during nonscouring flows has decreased from approximately 5.8 kg/d in 1978 to 1 kg/d in 1983. This decrease probably results from PCB depletion and fresh sedimentation within the sediment-mixing layer in addition to some remedial actions. When river discharge is sufficient to induce scouring, some contaminated riverbed sediments become resuspended; PCB-transport rates during these periods range from 10 to more than 150 kg/d. A major factor influencing PCB transport to the estuary during high flow, in addition to the magnitude and duration of maximum discharge, is whether the high flow originated predominantly in the subbasin above or below the contaminated reach. The availability of PCBs for scour-related transport has apparently decreased 50% since 1977. Approximately 10,000 kg of PCBs were transported to the estuary during 1977-83, of which 38% was the result of resuspension. (Author's abstract)
W88-04561

OCCURRENCE OF ORGANIC MICRO-POLLUTANTS IN THE VAAL RIVER BETWEEN GROOTDRAAI DAM AND PARYS,
National Inst. for Water Research, Pretoria (South Africa).
R. A. Van Steenderen, S. J. Theron, and A. J. Hassett.
Water SA, Vol. 13, No. 4, p 209-214, August 1986. 9 fig, 4 tab, 12 ref.

Descriptors: *Path of pollutants, *Vaal River, *Grootdraai Dam, *South Africa, *Pollutant identification, Water pollution sources, Organic compounds, Water quality, Drinking water, Dibutyl phthalate, Phenols, Chemical analysis, Gas chromatography, Mass spectrometry.

The Vaal Dam - Vaal River Barrage system is a source of drinking water for approximately 40% of the population of the Republic of South Africa. This system also serves as a recipient of a multitude of organic compounds derived from numerous activities in the catchment area. Below the Vaal River Barrage a number of point source contamination sites were identified which could affect the water quality for the users further down the river. The occurrence of organic compounds between the Grootdraai Dam and Parys was investigated. Twenty-five organic compounds were identified by gas chromatography - mass spectrometry. Dibutyl phthalate and phenol were found at all the sampling points although their concentrations were considerably higher at sampling points below the Barrage. (Author's abstract)
W88-04564

QUANTITATIVE ANALYSIS OF LIGNOSULPHONATE USING BENZETHONIUM CHLORIDE - PRELIMINARY INVESTIGATIONS,
Natal Univ., Durban (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5A.
W88-04566

EFFECTS OF HYDROLOGICAL FACTORS ON RIVER SUSPENDED SOLIDS CONTAMINATION FROM A COLLIERY IN SOUTH WALES,
University Coll. of Swansea (Wales). Dept. of Ge-

ography.
S. C. Bird.
Hydrological Processes HYPRE3, Vol. 1, No. 4, p 321-338, November 1987. 6 fig, 5 tab, 51 ref.

Descriptors: *Water pollution sources, *Hydrologic properties, *Suspended solids, *Wales, *Coal mines, Wastewater pollution, Model studies, Statistical analysis, Statistical models, Regression analysis.

Suspended solids contamination caused by runoff below a working coal mine in the Upper Clydach catchment in South Wales, U.K., was investigated in relation to hydrological controls. Field studies over a 16 month period found that concentrations below the colliery ranged from 4 to 8, 028 mg/L. Simple correlation and linear regression analysis of spot and storm event samples taken below the coal mine gave a correlation coefficient of 0.39 between flow and suspended solids concentration. Because of the lack of explained variance, a multiple linear regression model of within-storm concentrations was derived using four selected independent variables. X sub 1, the time relation of the sample to the storm peak; log X sub 2, the stormflow at the time of sampling; log X sub 3, the baseflow at the time of sampling; and log X sub 4, an index of the storm intensity. Analysis of the entire data set gave an R-squared of 0.34. When the results from three atypical events were excluded however, the R-squared value improved to 0.65. Beta coefficients indicated that rising limb conditions (X sub 1) and intense storms (log X sub 4) along with dry antecedent conditions (log X sub 3) represent the worst combination of hydrological factors for producing suspended solids contamination. (Author's abstract)
W88-04572

EFFECTS OF WILDFIRE AND LOGGING ON STREAMWATER CHEMISTRY AND CATION EXPORTS OF SMALL FORESTED CATCHMENTS IN SOUTHEASTERN NEW SOUTH WALES, AUSTRALIA,
Forestry Commission of New South Wales, Beecroft (Australia).
For primary bibliographic entry see Field 4C.
W88-04574

QUALITY OF SUSPENDED AND BOTTOM SEDIMENTS OF THE ST. LAWRENCE SYSTEM (CANADA) (QUALITE DES SEDIMENTS EN SUSPENSION ET DE FOND DU SYSTEME SAINT-LAURENT (CANADA)),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 4, p 445-467, December 1987. 7 fig, 5 tab, 46 ref.

Descriptors: *Water quality, *St. Lawrence River, *Bottom sediments, *Water pollution sources, *Path of pollutants, *Canada, *Suspended sediments, *Ecological effects, Water resources development, Suspended solids, Phosphorus, Polychlorinated biphenyls, Copper, Lead, Metals, Estuaries, Organic matter, Organic compounds, Mixing.

In the waters of the St. Lawrence River (Canada) the concentration of suspended solids varies from 4 to 10 mg/l in the region upstream of Lake St-Pierre and from 30 to 50 mg/l in the downstream region up to Quebec City. With the exception of the Sorel delta, this portion of the St. Lawrence system does not have important sediment traps. The concentrations of SiO2, Al2O3, Fe2O3, CaO and MgO are essentially similar to those in bottom sediments and soils in the region. However, bottom sediments are enriched in phosphorus, polychlorinated biphenyls, copper and lead. The portion of the St. Lawrence system immediately upstream of Orleans island, where the fresh water of the river mixes with the saline water of the gulf, constitutes a zone of high concentrations of suspended solids (up to 300 mg/l). In the estuary and the gulf of the St. Lawrence, the suspended sediment profile is, on the whole, characterized with a concentration decreasing from Orleans island (40-80 mg/l) to the St. Lawrence Gulf (1-2 mg/l). In the St. Lawrence Gulf, there exists a correlation between the pattern of surface water circulation and the concentrations of suspended matter. (Author's abstract)
W88-04591

LONG-TERM POLLUTANT DEGRADATION IN THE UNSATURATED ZONE WITH STOCHASTIC RAINFALL INFILTRATION,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
M. J. Small, and J. R. Mular.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2246-2256, December 1987. 8 fig, 2 tab, 59 ref. NSF Grant No. CEE-83-07060.

Descriptors: *Fate of pollutants, *Unsaturated zone, *Groundwater pollution, *Mathematical analysis, *Rainfall infiltration, Infiltration, Simulation analysis, Monte Carlo method, Path of pollutants, Mathematical models.

Given the discharge of a reactive material to the land surface, the fraction of the contaminant that reaches the underlying aquifer is uncertain due to variations in the rate of precipitation and infiltration. A stochastic conceptual framework is developed to estimate this variation. The framework relates the pollutant leachate fraction to the long-term rate of infiltration and derives the probability of a given leachate fraction from the probability of obtaining the associated infiltration rate. Application of the methodology is illustrated for the case where cumulative infiltration is represented by a compound Poisson process and pollutant fate is determined for one-dimensional advective-dispersive transport with linear equilibrium adsorption and first-order chemical decay. The derived probability model for this case compares favorably to results from Monte Carlo simulations of a numerical transport model. Applications and limitations of the methodology with more sophisticated transport, reaction, and stochastic infiltration models are considered. (Author's abstract)
W88-04605

SAMPLE VOLUME EFFECTS ON SOLUTE TRANSPORT PREDICTIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. C. Parker, and K. A. Albrecht.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2293-2301, December 1987. 4 fig, 4 tab, 33 ref, 2 append. Virginia Dept. of Health and Virginia Soil and Water Conservation Commission Project No. S-185.

Descriptors: *Soil water, *Solute transport, *Path of pollutants, *Cores, Saturated flow, Flow profiles, Permeability coefficient, Monte Carlo method, Mathematical analysis, Mathematical studies.

Saturated hydraulic conductivities (K sub s) and solute dispersivities under saturated flow conditions (lambda) were determined in the laboratory on cores of three different volumes (92, 471, and 1770 ml) taken at two depths in different soil layers along closely spaced parallel transects. Variances of ln K sub s decreased and mean lambda increased with increasing core volume reflecting greater within-core and lower between-core velocity variations for larger cores. Mean K sub s values were significantly lower for the smallest core size suggesting structural disturbance. To investigate effects of sample volume on reduced time field scale transport predictions, Monte Carlo simulations were carried out. From multinormal joint probability distributions of ln K sub s and ln lambda for the two layers, mean breakthrough curves were generated for each soil layer separately and as a two-layer system using a vertical stream tube approach with transverse mixing ignored. To evaluate effects of uncertainty in parameter estimates due to the finite sample number, a second level Monte Carlo analysis was performed assuming normally distributed, independent errors in the estimated means and covariances of parameters for the two layers. Differences between breakthrough curves predicted for each core size were relatively small and within 95% error bounds for the means. (Author's abstract)
W88-04610

SOLUTIONS FOR TRANSPORT OF TWO SORBED SOLUTES WITH DIFFERING DISPERSION COEFFICIENTS IN SOIL,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2G.
W88-04629

ORGANIC COMPOUND EFFECTS ON SWELLING AND FLOCCULATION OF UPTON MONTMORILLONITE,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W88-04631

MECHANISM BY WHICH ORGANIC LIQUIDS INCREASE THE HYDRAULIC CONDUCTIVITY OF COMPACTED CLAY MATERIALS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 2G.
W88-04632

ADSORPTION AND OXIDATION OF PHENOLIC COMPOUNDS BY IRON AND MANGANESE OXIDES,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
M. B. McBride.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1466-1472, November-December 1987. 3 fig, 2 tab, 33 ref. NSF Grant No. EAR-8512226.

Descriptors: *Adsorption, *Oxidation, *Phenols, *Iron, *Manganese, *Soil properties, *Solute transport, Spectrometry, Fourier analysis, Model studies, Soil chemistry, Organic compounds.

The adsorption and oxidation of catechol and hydroquinone by Fe and Mn oxides has been investigated by Fourier transform infrared spectroscopic (FTIR) analysis of the adsorbed molecules and by the measurement of O2 consumption by aqueous suspensions of these oxides. Evidence for direct coordination of catechol and salicylate to surface Fe(3+) on iron oxides was obtained by FTIR. The promotion of catechol and hydroquinone oxidation by Fe and Mn oxides was confirmed by measured rates of O2 consumption and by the appearance of Fe(2+) and Mn(2+) in the solutions. However, only trace levels of soluble Fe(2+) were detected, suggesting that oxidation by Fe(III) oxides was catalytic in that electron transfer between the phenols and Fe(3+) generated Fe(2+), which was rapidly reoxidized by O2. Other adsorbates introduced into these oxide/phenol systems, such as acetate, phosphate, and Cu(2+), diminished O2 consumption rates, but the effect was generally attributable to a lowered pH that inhibited oxidation. A model of surface oxidation by Mn and Fe is presented in which coordination of the organic at the surface is a prerequisite to electron transfer. Oxidation of organics can proceed with or without the uptake of O2, depending largely on pH, which determines the rate of reoxidation of the reduced metal ions by O2. The results emphasize the difficulty in interpreting the effects that chemical buffers have on oxidation reactions at oxide surfaces. (Author's abstract)
W88-04634

SIMPLE KINETIC FRACTIONATION OF REACTIVE ALUMINUM IN SOIL 'SOLUTIONS',
Vermont Univ., Burlington. Dept. of Physics.
R. J. Bartlett, D. S. Ross, and F. R. Magdoff.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1479-1482, November-December 1987. 2 fig, 2 tab, 18 ref. EPRI Contract No. RP2365 and DOE Contract No. DE-AS05-83FR60179.

Descriptors: *Kinetics, *Chemical reactions, *Aluminum, *Soil chemistry, *Leaching, *Weathering, *Acid rain, Soil properties, Soil water, Chemical analysis, Fate of pollutants.

A method is described that empirically measures the highly reactive portion of Al in 50 to 1000 microliter soil 'solution' samples such as those removed from field moist soil by pressure, centrifuging, immiscible displacement, or lysimetry. Three categories of Al reactivity are identified in a single sample: rapidly reacting (RR Al), moderately rapid (MR Al), and total reactive Al (TR Al). Compared with other operational kinetic methods for labile Al, this method is applicable to small samples and is quick, simple, and precise because measurement is integrated over a period of minutes rather than confined to a single time point observation. Correcting for Fe interference does not require reduction and complexation procedures that alter Al speciation. Because of its sensitivity to very small changes in reactivity in Al, this method should be useful for the experimental evaluation of possible increases in mobility of biologically active soil Al, such as those hypothesized to be induced by acid precipitation. (Author's abstract)
W88-04635

PHOSPHORUS REDISTRIBUTION FROM CULTIVATED FIELDS INTO RIPARIAN AREAS,
North Carolina Agricultural Research Service, Raleigh.
J. R. Cooper, and J. W. Gilliam.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1600-1604, November-December 1987. 4 fig, 4 tab, 21 ref.

Descriptors: *Phosphorus, *Path of pollutants, *Riparian lands, *Sedimentation, *Orthophosphates, *Cultivation, Water pollution sources, Equilibrium, Riparian waters, Soil chemistry, Runoff, Swamps, Flood plains, Clays, Solute transport.

The accumulation of P in sediments deposited within riparian areas was measured to study the role of these areas as P sinks. The sediments originated from the cultivated fields and forests of the uplands and were deposited during the last 20 to 25 years. The riparian areas were studied in the Atlantic Coastal Plain and consisted of four field-forest edges, four ephemeral streams and four flood plains of intermittent streams that flowed into a flood plain swamp. Selective sorting and deposition of sand and silt near the field-forest edge (0-20 m) and clay deposition downstream (1-4 km) on the flood plains and swamps explained much of the total P distribution in the riparian areas. The P in the sediments increased with percent clay, R-squared = 0.80. Laboratory measurements of the equilibrium phosphorus concentration (EPC) in flood plain swamp sediments were two to three times higher than P concentrations in the overlying water (1.0 vs. 0.4 micromol P/l) during high flow stages of winter and spring. During summer and fall, the ortho-P concentrations of isolated pools and base flow ranged from 1.0 to 1.3 micromol P/l. Approximately 260 kmol of P were deposited in the riparian areas of the 1850 ha watershed during the past 20 to 25 years. The amount of P deposited was equal to the amount estimated to have been removed from the watershed in the drainage water. About 50% of the P leaving agricultural fields appeared to be removed from the runoff water in the riparian areas. Riparian areas between the field edge and a perennial stream were sinks for P because of the continual deposition of fresh sediment from upland areas. (Author's abstract)
W88-04647

GREAT LAKES CLEANUP EFFORT: MUCH PROGRESS, BUT PERSISTENT CONTAMINANTS REMAIN A PROBLEM,
For primary bibliographic entry see Field 5G.
W88-04659

STREAM CHANNEL EROSION CONTRIBUTION TO SEDIMENT YIELDS IN COMPLEX WATERSHEDS,
Agricultural Research Service, Oxford, MS.
For primary bibliographic entry see Field 2J.
W88-04676

MODELING WATER QUALITY VARIABLES OF THE POTOMAC RIVER AT THE ENTRANCE TO ITS ESTUARY, PHASE I: TREND AND SEASONALITY,
George Washington Univ., Washington, DC. International Water Resources Inst.
J. T. B. Obeysekera, and V. Yevjevich.
Available from the National Technical Information Service, Springfield, VA. 22161, PB87-172656. January 1985. 120 p, 68 fig, 26 tab, 22 ref.

Descriptors: *Potomac River, *Water quality, *Seasonal variation, *Model studies, *Estuaries, Dissolved oxygen, River Flow, Conductivity, Nitrate, Alkalinity, Hydrogen ion concentration, Dissolved solids, Temperature, Chemical oxygen demand, Chlorine demand, Algae, Eutrophication, Monitoring.

The Potomac River is the second largest tributary to the Chesapeake Bay. The Potomac originates in the Appalachian Mountains and flows southeasterly its Fall Line at Great Falls, Virginia, below which the river is tidal. The Potomac estuary below the Fall Line is used for many purposes including industrial water supply, navigation, recreation and commercial fishing. The Washington metropolitan area has a direct influence on the state of the Potomac estuary in general and water quality conditions in particular. Beginning in the late 1940's and early 1950's, the use of the estuary has been hampered occasionally by the occurrence of low level dissolved oxygen (DO) and nuisance blooms of macroscopic and microscopic plants. Occurrences of floating algal mats also have been reported. In the 1960's, the Potomac estuary was in an advanced state of eutrophication characterized by massive blue-green algae blooms and frequent low DO levels. The present research project sought to improve the accuracy in modeling of nonpoint source water quality and flow in the Potomac River basin. The phase of the project reported here has the following objectives: (1) detection of changes (trends, jumps, etc.) in water quality input to the Potomac estuary, and (2) detection and modeling of seasonality in concentrations of water quality input to the Potomac estuary. Application of nonparametric methods and a Fourier series approach for detection of seasonality yielded the following general conclusions: (1) most of the water quality constituents and other variables observed at Chain Bridge exhibit seasonal variations; (2) the seasonality may be present in probability distribution in general or in one or more of the statistical parameters such as mean and standard deviation. A strong seasonality is indicated for discharge, conductivity, alkalinity, dissolved phosphorus, nitrate, dissolved oxygen, temperatures, chemical oxygen demand, chloride demand, and pH. (Lantz-PTT)
W88-04707

ACID PRODUCING POTENTIAL OF THE VARIOUS LITHIC UNITS ASSOCIATED WITH THE MINING OF COAL,
West Virginia Univ., Morgantown. Water Research Inst.
J. J. Renton, and A. H. Stiller.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-124912/AS. Price codes: A03 in paper copy, A01 in microfiche. Water Research Institute Completion Report of Project G-941-03 and G-1052-03, 1986. 16 p, 2 fig, 3 tab, 2 ref. Contract No. 08-0001-G1052 and 08-0001-G941. Project No. USGS G941-03 and G1052-03.

Descriptors: *West Virginia, *Acid mine drainage, *Chemical potential, *Coal mines, Chemical properties, Geochemistry, Land reclamation, Mathematical analysis, Mathematical models, Mine wastes, Rock properties, Statistical analysis, Sulfur.

A collection of the seven different potentially toxic lithotypes encountered in the mining of coal were collected for five coals in 18 mines over a 5 county area in northern West Virginia for a total of 89 samples. Each sample was subjected to total sulfur analysis and to the soxhlet extraction/oven reoxidation procedure devised for the evaluation of an acid production rate constant, alpha. Because of the limited sampling, few definite statements can be made. It appears that the individual lithic units do not have diagnostic acid production parameters. The data do show that the acid production potential of the seatearth is significantly greater than any other lithic unit. The data show that the samples with the lowest sulfur contents have the highest acid production rate constants. The data also show that acid production rates vary significantly among samples of equal or nearly equal sulfur content indicating that parameters other than concentration of sulfur affect acid production. (Renton-WV U.)
W88-04743

HYDROSPHERIC TRACE ELEMENTS AND THEIR APPLICATION IN TRACING WATER POLLUTANTS,
Oregon State Univ., Corvallis. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-04747

RECHARGE TO AND POTENTIAL FOR CONTAMINATION OF AN AQUIFER SYSTEM IN NORTHEASTERN WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W88-04752

POTENTIAL FOR MIGRATION OF HAZARDOUS WOOD-TREATING CHEMICALS DURING LAND TREATMENT OPERATIONS,
Mississippi State Univ., Mississippi State. Dept. of Botany.
G. D. McGinnis.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116785/AS. Price codes: A07 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report G1234, July 1987. 122 p, 38 fig, 45 tab, 111 ref. Contract No. 14-08-0001-G1234. Project No. USGS G1234-03.

Descriptors: *Organic wastes, *Path of pollutants, *Land disposal, *Hazardous chemicals, *Microbial degradation, Migration, Groundwater pollution, Aromatic hydrocarbons, Phenols, Dioxin, Mississippi, Water pollution sources.

This project is an extension of the project undertaken jointly by the Environmental Protection Agency, Southern Pressure Treaters Association, and Mississippi Forest Products Laboratory. The overall objective of this study is to determine the amount and type of toxic chemicals that migrate into the groundwater during active land treatment operations. All the sites used for this study have been characterized. The hazardous waste at each site has been characterized chemically using a variety of parameters. Determination of the rates of microbiological degradation is complete. Studies on migration patterns are still in progress and should be complete later this year. A demonstration field site is being built at Wiggins, Mississippi, and will be in operation this summer to evaluate the results from the laboratory studies. The principal findings are that all the sites had bacteria that could degrade polycyclic aromatic hydrocarbons and pentachlorophenol but not octachlorodibenzo-p-dioxin. The relative rates varied for each constituent and depended on the soil type. The organic carbons were found to be very important for the breakdown of pentachlorophenol. (McGinnis-MS. St. U.)
W88-04754

COLIPHAGES AS AN INDICATOR OF FAECAL POLLUTION IN WATER. ITS RELATIONSHIP WITH INDICATOR AND PATHOGENIC MICROORGANISMS,
Malaga Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W88-04847

TRANSPORT OF SOLUTES THROUGH UNSATURATED FRACTURED MEDIA,

Sandia National Labs., Albuquerque, NM. Fluid and Thermal Sciences Dept.
For primary bibliographic entry see Field 2F.
W88-04855

ADSORPTION, DESORPTION, AND ISOTOPIC EXCHANGE OF CADMIUM ON ILLITE: EVIDENCE FOR COMPLETE REVERSIBILITY,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Geochemistry.
R. N. J. Comans.
Water Research WATRAG, Vol. 21, No. 12, p 1573-1576, December 1987. 2 fig, 1 tab, 14 ref.

Descriptors: *Geochemistry, *Adsorption, *Desorption, *Isotope studies, *Cadmium, Illite, Kinetics, Heavy metals, Clay minerals, Hydrogen ion concentration, Temperature.

Adsorption, desorption, and isotopic exchange of Cd on illite clay were studied at low Cd concentrations and low ionic strength. The results indicate that under the conditions of the experiments Cd sorption on illite is completely reversible. For sorption experiments the initial pH was 7.79 and samples were maintained at 298 K for 54 days in a reciprocating shaker; for desorption, pH was maintained at 7.2 and the same temperature and other conditions of the experiment were used. Long equilibration times (7-8 wk) were essential because of slow desorption kinetics. (Author's abstract)
W88-04860

DROGUE-CLUSTER AND DYE-DISPERSION MEASUREMENTS,
Gore and Storrie Ltd., Toronto (Ontario).
M. D. Palmer, R. Jarvis, and L. Thompson.
Canadian Journal of Civil Engineering CJCEB, Vol. 14, No. 3, p 320-326, June 1987. 10 fig, 8 ref.

Descriptors: *Lakes, *Path of pollutants, *Dye dispersion, Drogue clusters, Surface streaking, Lake Ontario, Transport, Currents, Wind.

Dispersion and transport near the surface were measured extensively in the coastal regions of Lake Ontario (Canada) using dye patches and clusters of water sail and surface drogues. The measurements were carried out for 6-8 hr. Each method produced different measurements of dispersion magnitudes, with the largest dilution occurring for the dye, followed by sail drogue clusters (40% of the dye's value) and then surface drogue clusters (25% of the dye's value). Both the sail and surface drogues measured the two-dimensional dispersion. The means surface dispersion was about 50% less than the dispersion 1.5 m below the water surface. The dilution characteristics decreased as the water surface was approached. The sail dispersion was about half of the dye-dispersion data. An unknown amount of the difference may have been due to the dye patch measuring dispersion at a greater depth than the sail drogues, which were set for a depth of 1.5 m. The increase in variance with time of the various methods was compared. A method was devised for predicting dilution envelopes for a location using the path lines of the drogue-cluster centroids or center of mass of the dye patch for both batch release and continuous discharge. These dilution envelopes are based entirely on Lagrangian data for both the velocity and dispersion estimates. (Author's abstract)
W88-04866

DISTRIBUTION OF SILVER, MERCURY, LEAD, COPPER, AND CADMIUM IN CENTRAL PUGET SOUND SEDIMENTS,
Connecticut Univ., Groton. Marine Sciences Inst.
N. S. Bloom and, and E. A. Crecelius.
Marine Chemistry MRCHBD, Vol. 21, No. 4, p 377-390, October 1987. 3 fig, 8 tab, 20 ref. DOE Office of Energy Research Contract DE-AC06-76RLO 1830.

Descriptors: *Heavy metals, *Sediments, *Pollution load, *Particulate matter, Puget Sound, Spatial distribution, Estuarine environment, Silver, Lead, Mercury, Cadmium, Copper.

Distributions of five toxic heavy metals were assessed for Puget Sound, Washington, sediments. Twenty-one Kasten cores were collected. Analysis by Zeeman-corrected graphite-furnace atomic absorption spectroscopy made possible for the first time the accurate and precise determination of Ag and Cd in Puget Sound sediments. Data show that Puget Sound is moderately impacted by anthropogenic Ag, Hg, Pb, and Cu. No enrichment of Cd was found. Puget Sound is quite well mixed with respect to the residence time of particle-bound metals. Toxic metal accumulation sites in the central Sound are determined almost exclusively by grain size, rather than proximity to sources. Estimates are made of trace metal fluxes to the sediments as a function of sediment type and areal distribution. (Author's abstract)
W88-04878

REGULATION OF STORM WATER POINT SOURCE DISCHARGES,
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 5G.
W88-04884

OIL-FIELD BRINE CONTAMINATION—A CASE STUDY, LEA COUNTY, NEW MEXICO,
New Mexico Inst. of Mining and Technology, Socorro.
D. B. Stephens, and C. P. Spalding.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 440-450, 4 fig, 8 ref.

Descriptors: *Brine disposal, *Path of pollutants, *Ogallala Aquifer, *Injection wells, *Groundwater pollution, Liability, Observation wells, Groundwater management, Case studies, Brines, Wastewater disposal, Monitoring, Underground waste disposal, New Mexico, State jurisdiction, Legal aspects.

Salt-water disposal practices in the Moore-Devonian oil field near Caprock, New Mexico produced a plume of contamination approximately one mile long in the Ogallala aquifer. Maximum chloride concentrations are nearly 26,000 milligrams/liter. The plume heads in the vicinity of an abondoned brine pit and an operating salt-water disposal well which injects brine underground at a depth of about 10,000 feet. There are also numerous pipelines, operating oil wells, and extensive areas scarred from brine spills. A court of law found that the abandoned pit and the injection well contributed to the contamination problem. Groundwater monitoring near injection wells is not required by State regulation; however, such observation wells emplaced when injection begins and monitored routinely would provide data necessary to protect freshwater resources. In areas of multiple potential sources of seepage, groundwater monitoring may also protect owners and operators of disposal facilities from liability. (See also W88-04894) (Author's abstract)
W88-04923

ROLE OF TIDAL WETLANDS IN THE RETENTION OF HEAVY METALS,
Rider Coll., Lawrenceville, NJ. Dept. of Biology.
R. L. Simpson, and R. E. Good.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 164-175, 1 fig, 6 tab, 33 ref.

Descriptors: *Tidal marshes, *Heavy metals, *Fate of pollutants, *Wetlands, Nonpoint pollution sources, Zinc, Lead, Delaware Bay, Chesapeake Bay, Path of pollutants, Hydrodynamics, Salt marshes, Salinity, Ecological effects.

Substantial quantities of heavy metals, largely from anthropogenic sources, enter the Chesapeake Bay daily. The Susquehanna, Potomac, and James Rivers contribute over half of the total metals loading to the Bay, with atmospheric and nonpoint source inputs adding significant quantities of zinc and lead, respectively. Metal retention paterns appear to be largely a function of wetland hydrodynamics, salinity, and substrate characteristics, indicating that individual tidal wetlands will differ in their ability to retain heavy metals. Information is scarce on both the rates of metal accumulation and the absolute capacities of tidal wetlands to retain heavy metals. However, urbanized freshwater tidal wetlands along the upper Delaware River estuary (Woodbury Creek Marsh, New Jersey) typically have soil metal levels two to three times those of wetlands in rural areas, suggesting that most wetlands can assimilate metals above current levels. While food chain dynamics as they relate to the transfer and movement of heavy metals through tidal wetlands are poorly understood, the vegetation and litter clearly act as temporal sinks for heavy metals and the soils are long-term sinks for metals. Thus, tidal wetlands such as those that fringe Chesapeake Bay and its associated estuaries play an important role in mitigating the impacts of heavy metals from upland and upstream ecosystems. Conservation of these wetlands is critical to the long-term health of the Bay. (See also W88-04934) (Lantz-PTT)
W88-04949

MODIFICATION OF ACID MINE DRAINAGE BY SPHAGNUM-DOMINATED WETLANDS AND THE EFFECT ON STREAM WATER QUALITY,
West Virginia Univ., Morgantown. Dept. of Biology.
G. E. Lang, and R. K. Wieder.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 176-184, 3 tab, 9 ref.

Descriptors: *Acid mine drainage, *Peat bogs, *Wetlands, *Water pollution control, *Fate of pollutants, *West Virginia, Coal mining, Path of pollutants, Iron, Adsorption.

A large part of the Chesapeake Bay's drainage basin overlaps with Appalachia, a region that supports considerable coal mining activities. Coal deposits underlie much of this area. Associated with the mining for coal is the formation of acid mine drainage which upon entering natural streams leads to a marked reduction in stream water quality. However, sphagnum-dominated wetlands in Appalachia have the ability to modify acid mine drainage, minimizing any adverse impacts on downstream water quality. This study, conducted at Tub Run Bog, a 23 ha wetland in Tucker County, West Virginia, illustrated that the two primary mechanisms for the removal of iron and its retention in the peat deposit are: (1) the incorporation of iron into an organically bound fraction by adsorption onto the peat, and (2) the formation of iron oxides. The former mechanism is clearly finite, with the maximum iron adsorption capacity of peat being a measurable quantity, while an upper limit on the accumulation of iron oxides has not been established. (See also W88-04934) (Lantz-LTT)
W88-04950

RADON, RADIUM AND OTHER RADIOACTIVITY IN GROUND WATER: HYDROGEOLOGIC IMPACT AND APPLICATION TO INDOOR AIRBORNE CONTAMINATION.
National Water Well Association, Worthington, OH.
Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. Lewis Publishers, Chelsea, MI. 1987. 546 p. Edited by Barbara Graves.

Descriptors: *Radon, *Radium radioisotopes, *Groundwater pollution, *Water pollution effects, Conferences, Geohydrology, Air pollution, Monitoring, Water quality, Radioactivity, Radioactivity effects.

The dangers associated with the inhalation of short-lived radon decay products have been well documented. The U.S. EPA estimates that radon contaminates one in eight U.S. homes and causes thousands of lung cancer deaths each year. The fact that groundwater is one of the many sources of radon contamination is cause for concern, considering the growing number of persons who rely

on this resource. This concern prompted the Association of Ground Water Scientists and Engineers and the U.S. EPA to host this conference on radon, radium, and other radioactivity in groundwater in Somerset, New Jersey, on April 7-9, 1987. The conference sessions focused on the following topics: geologic and hydrogeologic controls influencing radon occurrence; monitoring radon, radium, and other radioactivity from geologic and hydrogeologic sources; mining impacts on the occurrence of radon, radium, and other radioactivity in groundwater; sampling and analysis of radon, radium, and other radioactivity in groundwater; radon and radium in water supply wells; predictive models for the occurrence of radon, radium, and other radioactivity; and remedial action for radon, radium, and other radioactivity. (See W88-04981 thru W88-05012) (Lantz-PTT)
W88-04980

GEOLOGIC CONTROLS AND RADON OCCURRENCE IN NEW ENGLAND,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2K.
W88-04982

EFFECT OF URANIUM SITING IN TWO-MICA GRANITES ON URANIUM CONCENTRATIONS AND RADON ACTIVITY IN GROUND WATER,
Shevenell Gallen and Associates, Inc., Portsmouth, NH.
J. B. Wathen.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 31-46, 3 fig, 1 tab, 18 ref, 4 plates.

Descriptors: *Uranium, *Radon, *Groundwater pollution, *Radioisotopes, *Granite, *Well water, *Water pollution sources, Path of pollutants, Geology, Geohydrology, Feldspar, Maine, New Hampshire, Leaching, Wells.

Two-mica granites have been identified as having the potential to yield groundwater containing elevated levels of Rn-222. Wide variations between individual wells and between average activities for wells drilled into apparently lithologically similar rock bodies suggest complex controls on factors predisposing high radon concentrations in groundwater. Research into factors affecting levels of Rn-222 was conducted on wells drilled into four two-mica plutons in Maine and New Hampshire. The study included the analysis of the well water samples for uranium concentration as well as autoradiographic studies of rock samples from outcrops spatially associated with the specific wells. Photomicrographs of the rocks and the exposed autoradiographs were compared. In all the two-mica rock samples studied, uranium was found to be sited along grain boundaries, in microcracks, and on alteration sites in the rock rather than in discrete mineral phases. Groundwater with the higher concentrations of uranium was found to be associated with the siting of the uranium on altered plagioclase feldspar grains in the granite. Lower uranium concentrations and lower and less variable activities of Rn-222 was associated with the siting of uranium on altered biotite grains. The distinction between these two modes of siting may be attributable to the relative strength with which the uranium is retained in the two types of sites. The uranium is retained on the ferric hydroxide alteration sites on the biotite approximately 1,000,000 more strongly than on the altered plagioclase. The relatively loose retention of uranium on altered plagioclase grains provides the basis for mechanisms for the leaching, transport, and reconcentration of uranium. One implication of the existence of accumulations of uranium is that groundwater in contact with secondary uranium mineralization will be in contact with the decay products of the uranium. This includes radon, which of all the isotopes in the U-238 decay chain, is the most soluble in groundwater. (See also W88-04980) (Author's abstract)
W88-04983

SOURCE AND DISTRIBUTION OF NATURAL RADIOACTIVITY IN GROUND WATER IN THE NEWARK BASIN, NEW JERSEY,
Geological Survey, Trenton, NJ.
O. S. Zapecza, and Z. Szabo.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 47-68, 5 fig, 30 ref.

Descriptors: *Water pollution sources, *Radioactivity, *Radioisotopes, *Groundwater pollution, *Newark, *New Jersey, Uranium, Groundwater supply, Radiation, Geophysics, Gamma rays, Geology, Geochemistry, Sandstone, Wells.

Elevated levels of naturally occurring radionuclides in groundwater are associated with uranium enrichment in the Newark Basin of New Jersey. The factors controlling the concentration, distribution, and migration of these radionuclides in groundwater are being studied by the U.S. Geological Survey, in cooperation with the New Jersey Department of Environmental Protection, Division of Water Resources. Groundwater from 260 sites in the basin was analyzed to determine the distribution of gross alpha-particle radiation. High levels of gross alpha radiation (> 15 piC/L maximum contaminant level established by the U.S. EPA) were found predominantly in groundwater near the contact of the Lockatong and Passaic Formations along the southeastern part of the basin, and in the Hopewell and Flemington fault blocks, where these formations are repeated. The source of the radioactivity has been determined by borehole geophysical testing and analysis of lithologic cores. Natural gamma-ray logs of wells near the Lockatong-Passaic contact depict thin but laterally extensive zones of high radioactivity. Analysis of lithologic cores of these zones indicates that uranium is concentrated in black mudstones that contain abundant pyrite mineralization. The color and mineralogy of the radioactive beds suggests that the uranium was deposited in a reducing environment. This is consistent with the geochemical behavior of uranium precipitating in reducing environments and mobilizing in oxidizing environments. The uranium-bearing black mudstones, which are common in the Lockatong and lower Passaic Formations, are the primary source of radionuclides in the groundwater of the basin. The upper part of the Passaic Formation, which is composed primarily of red shale and sandstone, contains groundwater with relatively low concentrations of radionuclides. Localized and widely scattered occurrences of elevated radioactivity in groundwater are found in the sandstone of the Stockton Formation. Groundwater from the basalt and diabase aquifers in the basin contains low levels of radionuclides. (See also W88-04980) (Author's abstract)
W88-04984

ELEVATED LEVELS OF RADIOACTIVITY IN WATER WELLS IN LOS ANGELES AND ORANGE COUNTIES, CALIFORNIA,
Alton Geoscience, Irvine, CA.
J. Wiegand, G. Yamamoto, and W. Gaston.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 71-82, 5 fig, 3 tab, 2 ref.

Descriptors: *Radioactivity, *Well water, *Groundwater pollution, *California, *Fate of pollutants, *Radon, *Radium radioisotopes, *Uranium, Path of pollutants, Groundwater quality, Drinking water, Water quality control, wells.

Levels of gross alpha particle radioactivity nearly three times the maximum contamination levels (MCL) have been detected for several years in well waters and related surface waters in Los Angeles and Orange Counties, California. A few elevated levels of uranium have also been recorded. The affected wells and related surface waters represent only a minor fraction of water sampled and tested in this area. None of the excessive radioactivity is believed to persist in the municipal waters sold to the public, due to the customary blending of waters from several wells or sources which water purveyors practice. Presented here is a preliminary survey of the occurrence, possible sources, fate, and implications of these elevated radioactivity levels. Very little is known about the radionuclides derivative from the gross alpha and uranium detected, although no elevated levels of radium-226 were reported in Los Angeles County. The presence of radium-228, and/or radon-222 in significant quantities cannot be ruled out. If the blending of water supplies from several wells maintains the water offered to the public within the MCLs, then no problem can be said to exist. Similarly, if the trend over time is for a relative decrease in the levels of gross alpha as a high water throughput disperses and dilutes the radioactive contaminants, then health risks should diminish. The converse of these conditions also might occur. (See also W88-04980) (Lantz-PTT)
W88-04985

PRELIMINARY ASSESSMENT OF FACTORS AFFECTING RADON LEVELS IN IDAHO,
Tennessee Technological Univ., Cookeville. Water Resources Center.
A. E. Ogden, W. B. Welling, R. D. Funderburg, and L. C. Boschult.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 83-96, 7 fig, 5 tab, 8 ref.

Descriptors: *Air pollution, *Radon, *Groundwater pollution, *Idaho, *Fate of pollutants, *Housing, Surveys, Water pollution effects, Geohydrology, Granite, Radioactivity, Aquifers.

Much of Idaho is underlain by granitic and related rocks associated with the Idaho Batholith. Since granitic-type rocks commonly have higher concentrations of radium which decays to radon, the Idaho Division of Environment obtained a grant from the Idaho Cancer Coordinating Committee to survey radon levels throughout the state. The results of the first phase of this state-wide survey are presented along with an examination of the possible factors affecting these levels in two Idaho counties. The results indicate that earth covered homes have the highest radon levels, but the presence or absence of a basement or crawl space does not appear to significantly affect radon levels. Also, there was no significant difference between homes that are weatherized versus those that are not. The type of heating in the homes and presence or absence of an air cleaning system also seem to have little influence on the radon levels. A more detailed look at radon levels in Ada and Kootenai counties suggests that levels are higher if the home is near a fault and also where the water tables is deeper. The greater the granitic composition of the alluvium and outwash on which homes are built, the greater the possibility of higher radon levels. (See also W88-04980) (Lantz-PTT)
W88-04986

NATURAL RADIOACTIVITY IN SOME GROUNDWATERS OF THE CANADIAN SHIELD,
Atomic Energy of Canada Ltd., Pinawa (Manitoba).
A. E. Lemire, and M. Gascoyne.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 97-110, 3 fig, 6 tab, 14 ref.

Descriptors: *Groundwater pollution, *Canada, *Radioactivity, *Water pollution sources, *Pollutant identification, Uranium, Radon, Radium, Wells, Groundwater quality, Geochemistry, Geohydrology, Granite, Bicarbonates.

High levels of uranium and radon were found in some individual wells in the Lac du Bonnet region

of Manitoba. Considerable variation in concentration was observed between individual wells located within a small geographic area. The cause of the individual high concentrations is thought to be a combination of localized enrichment in overburden and granitic bedrock and of the high bicarbonate oxygenated groundwater of the region. A similar survey was carried out in the Atikokan region of northwestern Ontario. Uranium concentrations were low, but high radon levels were observed in some drill holes. At the Atikokan site, the presence of significant excess radon correlated with proximity to fault zones in the granitic bedrock. As a remedial measure, a uranium and radium removal system for individual household use was designed and tested and is now available commercially. (See also W88-04980) (Lantz-PTT)
W88-04987

DETERMINATION OF BULK RADON EMANATION RATES BY HIGH RESOLUTION GAMMA-RAY SPECTROSCOPY,
Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W88-04988

RADON IN GROUNDWATER OF THE LONG VALLEY CALDERA, CALIFORNIA,
Lawrence Berkeley Lab., CA.
S. Flexser, H. A. Wollenberg, and A. R. Smith.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 131-149, 11 fig, 2 tab, 13 ref. DOE Contract No. DE-AC03-76SF-00098.

Descriptors: *Path of pollutants, *Radon, *Groundwater pollution, *California, *Long Valley, *Pollutant identification, Water temperature, Conductivity, Fate of pollutants, Groundwater quality, Monitoring, Geohydrology, Radioisotopes, Uranium, Earthquakes.

In the Long Valley caldera, an area of recently (approximately 550 y) active volcanism and current seismic activity, 222-Rn concentrations in hot, warm, and cold spring waters have been measured since 1982. Rn contents of the waters correlate inversely with temperature and specific conductance, with high concentrations (1500 to 2500 pCi/l) occurring in dilute cold springs on the margins of the caldera, and low concentrations (12 to 25 pCi/l) in hot to boiling springs. Rn correlates only slightly with the uranium contents of the rocks which host the hydrological system feeding the springs, which encompass a wide range of rock types. Anomalous changes in groundwater Rn contents may accompany or precede earthquake activity, and a continuous Rn monitoring system was installed in 1983 to monitor short-term variations. A gamma detector was submerged in a natural pond fed by 11 C spring waters with about 700 pCi/l Rn; measured gamma activity was due almost entirely to 222-Rn in the water. The gamma record, which is integrated hourly, showed a consistent, pronounced diurnal variation (about 30% of mean count rate), and weaker higher frequency variations. This pattern correlates well with small variations (< 1 C) in water temperature at the Rn monitoring point, and is strongly influenced by precipitation and by patterns of water flow in the pond. It does not adhere closely to an earth tidal pattern. These environmental effects on the radon record may mask responses to small or distant seismic events. To date, anomalous changes in waterborne Rn have been observed in connection with at least one earthquake, which occurred close to the monitoring site. This continuing study points out that an understanding of the geological setting, its associated hydrological system, and environmental influences is necessary to properly evaluate concentrations and changes in groundwater radioactivity. (See also W88-04980) (Author's abstract)
W88-04989

RADIOACTIVITY IN HOCKING RIVER BASIN,
Ohio Univ., Athens.
M. U. Ahmad, and R. W. Finlay.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 153-170, 4 fig, 1 tab, 30 ref.

Descriptors: *Radioactivity, *Hocking River, *Ohio, *Path of pollutants, *Environmental effects, Potassium radioisotopes, Uranium radioisotopes, Thorium radioisotopes, Coal mining, Drinking water, Shale, Stream sediments, Municipal water, River water.

The way in which radiological burdens are altered by coal mining activities, were examined in an Appalachian watershed, the Hocking River Basin, Ohio. This study sought to identify specific nuclides and their respective concentration in various mediums. The concentrations of 40-K, 238-U, 235-U, 232-Th and their respective daughter products are determined for the major mineable coal seams, their associated roof shales and other miscellaneous lithologies located in the Hocking River Basin. In addition, the concentrations of these nuclides are also determined for stream sediments and water samples from the Hocking River and its major tributaries. The maximum and minimum uranium concentrations are: for coal, 14.97 micrograms/g (8 Redstone Coal) and 0.03 micrograms/g (6 Middle Kittanning Coal) respectively; and for shale, 9.82 micrograms/g (Harlem shale) and 0.06 micrograms/g (Middle Kittanning roof shale). The maximum and minimum thorium concentrations are: for coal, 7.32 micrograms/g (8A Redstone Coal) and 0.11 micrograms/g (6 Middle Kittanning Coal); and for shale, 7.57 micrograms/g (Lower Freeport roof shale) and 0.17 micrograms/g (Middle Kittanning roof shale). The alpha activity of a treated water sample from the Athens municipal water supply is: 0.013 pCi/l for 235-U, 0.220 pCi/l for 234-U, and 0.180 pCi/l for 238-U. These values are slightly below the average alpha activity of the river water samples. The alpha activity of the river water samples discussed in this study, is considerably below the 15 pCi/l gross alpha activity maximum contaminant level (MCL) set by the US EPA for potable drinking water supply standards. (See also W88-04980) (Lantz-PTT)
W88-04990

FACTORS CONTROLLING URANIUM AND RADIUM ISOTOPIC DISTRIBUTIONS IN GROUNDWATERS OF THE WEST-CENTRAL FLORIDA PHOSPHATE DISTRICT,
C. L. Humphreys.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 171-189, 7 fig, 3 tab, 15 ref.

Descriptors: *Path of pollutants, *Uranium radioisotopes, *Radium radioisotopes, *Groundwater pollution, *Florida, *Phosphate mining, Environmental effects, Aquifers, Radioisotopes, Drinking water.

Phosphorite sediments are enriched in 238-U and its decay daughters including 234-U and 226-Ra. It has been suggested that the extent to which these radioisotopes interact with and are distributed throughout the hydrosphere is enhanced by phosphate mining operations. Groundwater and aquifer materials from mined, mineralized but unmined and from economically unmineralized areas were analyzed to determine uranium and Ra-226 content and 234-U/238-U and 226-Ra/238-U activity ratios. Samples were obtained from all three aquifers that underlie the area: the surficial, secondary artesian and Floridan aquifers. The data were then correlated with prevailing hydrogeochemical conditions to determine to what degree mining operations alter natural conditions with respect to the distribution of uranium-series isotopes. Impacts of the phosphate mining process appear to be overridden by natural conditions with respect to radioisotopic distributions of uranium and radium in groundwaters of the study area. These natural phenomena include: (1) the presence of a uranium source, either a primary enrichment or a secondary accumulation; and (2) the residence time of groundwater within the flow system which directly influences oxidation-reduction potential and total dissolved solid content of groundwater. Data indicate that mining operations appear to slightly alter natural uranium distributions. Radium concentrations and distributions were not affected by mining operations. Highest concentrations of 226-Ra and excessively high 226-Ra/238-U activity ratios were found to occur in aquifers of the downgradient, unmineralized portion of the study area. Average concentrations of 226-Ra exceeded the US EPA drinking water standard of 5.0 pCi/l for combined activities of radium isotopes in this portion of the study area. Groundwater quality in the unmineralized downgradient area, specifically, high total dissolved solids and low oxidation-reduction potential, are a product of a longer residence time. (See also W88-04980) (Lantz-PTT)
W88-04991

SAMPLING AND ANALYSIS OF DISSOLVED RADON-222 IN SURFACE AND GROUND WATER,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5A.
W88-04992

RADON-222 CONCENTRATION OF GROUNDWATER FROM A TEST ZONE OF A SHALLOW ALLUVIAL AQUIFER IN THE SANTA CLARA VALLEY, CALIFORNIA,
Stanford Univ., CA. Dept. of Civil Engineering.
L. Semprini.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 205-218, 4 fig, 3 tab, 22 ref. EPA Contract No. CR 812220.

Descriptors: *Radon, *Groundwater pollution, *Path of pollutants, *Alluvial aquifers, *Santa Clara, *California, *Geohydrology, Fate of pollutants, Geochemistry, Chemical analysis, Aquifers, Pollutant identification.

The short half-life of radon, its rapid equilibration in the pore fluid, and its inability to react with the solid matrix make the radon concentration a good indicator of changes in the emanation source caused by changes in local geologic conditions. These changes should be reflected in spatial variation in radon concentration of the groundwater. In this study, the radon concentration in groundwater from a experimental test zone in a shallow alluvial aquifer in the Santa Clara Valley, California, was measured to study its relationship to the hydrogeologic characteristics of the test zone. The objectives of the radon study were: (1) to measure the spatial variability of the groundwater's radon concentration over small distances to determine the concentration's relationship to the local hydrogeology; (2) to study the emanation rate of radon from aquifer core samples as a function of particle size; (3) to estimate the porosity on the aquifer based on emanation values and groundwater radon concentration; and (4) to assess whether emanation characteristics of the aquifer solids are consistent with the hydrogeologic relationships. The reasonable estimates of aquifer porosity based on the radon measurements, indicate that the emanation studies of aquifer solids performed in the laboratory in conjunction with measurements of groundwater radon concentration are of value in studying interactions of groundwater with the aquifer solid matrix. The emanation data support the hydrogeology data that suggest higher radon concentrations in the aquifer result from spatial heterogeneities in the solid matrix of the aquifer. Higher radon concentrations result from a zone of higher emanating sands upgradient of observation wells. The data indicate that the groundwater radon concentration results from emanation from both sands and gravels along the south-north transect. The data also suggest that contaminants in the groundwater flowing through the test zone will interact with a range of particle sizes. This information has impor-

tant implications on the fate and transport of contaminants through the test zone. (See also W88-04980) (Lantz-PTT)
W88-04993

NATIONWIDE DISTRIBUTION OF RA-228, RA-226, RN-222, AND U IN GROUNDWATER,
RPA International, Inc., Columbia, SC.
J. Michel, and M. J. Jordana.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 227-240, 4 fig, 2 tab, 16 ref.

Descriptors: *Path of pollutants, *Radium radioisotopes, *Radon radioisotopes, *Groundwater pollution, *Maps, *Distribution patterns, Uranium, Public waters, Drinking water, Water supply, Geochemistry, Aquifers.

Development of estimates of the number of public water supplies expected to have radionuclides (uranium, 226-Ra, 228-Ra, and 222-Rn) in the drinking water, and the number of people consuming drinking water having the radionuclides present at various levels of concern, are difficult because of the scarcity potential for bias of available measurements of public drinking water supplies. One approach funded by the US EPA was the development of a conceptual model for 228-Ra which predicted its occurrence in groundwater based on the geochemical and hydrological characteristics of the aquifer. This model was used to prepare the drinking water occurrence document for 228-Ra. The same approach was used for the estimation of uranium, 226-Ra, and radon occurrence in groundwater. It was the objective of this study to prepare nationwide maps, presenting the groundwater occurrence level estimates by county for these natural radionuclides. The occurrence levels area estimated semiquantitatively, using 3-5 categories of occurrence, with estimated concentration ranges associated with each category. (See also W88-04980) (Lantz-PTT)
W88-04995

RADON MEASUREMENT IN STREAMS TO DETERMINE LOCATION AND MAGNITUDE OF GROUND-WATER SEEPAGE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5A.
W88-04996

POLONIUM IN THE SURFICIAL AQUIFER OF WEST CENTRAL FLORIDA,
Florida State Univ., Tallahassee.
W. C. Burnett, J. B. Cowart, and P. A. Chin.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 251-269, 5 fig, 6 tab, 13 ref. Florida Inst. of Phosphate Research Contract No. 83-05-016S and State of Florida Dept. of Environmental Regulation Contract No. WM 147.

Descriptors: *Water pollution sources, *Polonium, *Aquifers, *Florida, Radon, Radioactivity, Chemical analysis, Pollutant identification, Hydrogen ion concentration, Well water, Acidic water, Sulfides.

Analysis of water from shallow wells in west central Florida has revealed the existence of a number of wells with high concentrations of 210-Po, a radioactive daughter of 222-Rn. Many concentrations are considerably higher than the Federal EPA maximum contaminant levels for total alpha radioactivity (15 pCi/l). These high concentrations are surprising in view of the particle-active nature of polonium. Measured 210-Po activities range from less than 1 to over 500 pCi/l in filtered samples, and from less than 1 to over 2,500 pCi/l in unfiltered samples. Measurements of 222-Rn showed a range from less than 100 to over 40,000 pCi/l and a range of 1 to 10 pCi/l for the longest lived radon daughter, 210-Po. The chemical characteristics of the waters high in polonium suggests a possible association between high 210-Po activity and acidic waters containing sulfide. (See also W88-04980) (Author's abstract)
W88-04997

TECHNIQUE FOR THE RAPID EXTRACTION OF RADON-222 FROM WATER SAMPLES AND A CASE STUDY,
University of Southern California, Los Angeles.
For primary bibliographic entry see Field 5A.
W88-04998

RADON SURVEY OF THE AMERICAN WATER WORKS SYSTEM,
American Water Works Service Co., Marlton, NJ.
For primary bibliographic entry see Field 5A.
W88-05000

EXTREME LEVELS OF 222-RN AND U IN A PRIVATE WATER SUPPLY,
Maine Univ., Orono. Dept. of Civil Engineering.
J. D. Lowry, D. C. Hoxie, and E. Moreau.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 363-375, 7 fig, 1 tab, 24 ref. EPA Grant No. R8108290.

Descriptors: *Radon, *Uranium, *Water supply, *Water pollution sources, *Path of pollutants, Water quality control, Air pollution, Activation carbon, Radioactivity, Adsorption, Water treatment.

There are legitimate health concerns associated with internal organ cancers for waterborne 222-Rn and with U toxicity at the extreme levels existing in water supplies. In addition, the elevated indoor air 222-Rn levels that result from waterborne 222-Rn via water use are a significant health concern in terms of lung cancer. Information is presented that updates previous studies about a private watr supply in Leeds, Maine, particularly the ramifications on treatment alternatives associated with the presence of both 222-Rn and U in a water supply. It is demonstrated that it is possible to effectively reduce elevated 222-Rn levels in indoor air through the removal of 222-Rn from the water supply. In situations where there are other significant contributors of 222-Rn, water treatment will only reduce the airborne 222-Rn in proportion to its contribution to the water supply. Based upon the results of this study, the following conclusions are made: (1) A water supply, with an extremely high 222-Rn level averaging 41,590 bq/l (1,124,000 pCi/l) was found to be contributing nearly 100% of the elevated 222-Rn measured in the indoor air; (2) A properly designed water treatment system is capable of bringing airborne 222-Rn levels down to normal background levels; (3) The granluated activated carbon (GAC) adsorption/decay steady state 222-Rn removal efficiency has ranged between 99.99% and 97.5%; (4) GAC has a significant capacity to adsorb U and removals in this application were nearly 100% for 100 to 200 days (1200 to 2400 bed volumes); (5) A saturation of the GAC with adsorbed U appeared to slightly reduce the efficiency of steady state 222-Rn removal, but does not appear to present a significant problem; and (6) A strong positive correlation between 222-Rn and gross alpha (U) was found for the influent concentrations. (See also W88-04980) (Lantz-PTT)
W88-05002

RADIUM-226 AND RADON-222 IN DOMESTIC WATER OF HOUSTON-HARRIS COUNTY, TEXAS,
Texas Univ. Health Science Center at San Antonio.
I. Cech, M. Lemma, H. M. Prichard, and C. W. Kreitler.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 377-402, 12 fig, 3 tab, 41 ref.

Descriptors: *Radium, *Radon, *Houston, *Harris County, *Texas, *Well water, *Domestic water, *Water quality, *Path of pollutants, *Water pollution sources, Water quality, Groundwater quality, Statistical analysis, Geohydrology, Recharge, Water depth, Salt domes.

Anomalous concentrations of 226-Ra and 222-Rn are shown to exist in the Greater Houston-Harris County area (Texas Gulf Coast). The findings summarized in this paper present an encouraging picture for predicting depths and locations in the Gulf Coast where elevated Ra and Rn concentrations may be encountered. Two to four key variables accounted for the statistically significant variation (from 38-74%) in concentrations observed under field conditions. The proximity of salt domes was a strong predictor of the presence of Ra and Rn in well water, particularly in combination with a certain range of pumping depths. The authors advise against developing domestic wells near salt domes, especially wells 180 m and deeper. (See also W88-04980) (Lantz-PTT)
W88-05003

RADIUM, RADON AND URANIUM ISOTOPES IN GROUNDWATER FROM CAMBRIAN-ORDOVICIAN SANDSTONE AQUIFERS IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, and J. B. Cowart.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 403-422, 8 fig, 22 ref.

Descriptors: *Radium, *Radon, *Uranium, *Groundwater pollution, *Water pollution sources, *Illinois, *Geochemistry, Path of pollutants, Thorium, Radioisotopes, Drinking water Barite, Radioactivity, Chemical analysis, Bedrock, Sandstone, Geohydrology, Aquifers.

The regional occurrences of selected radioactive isotopes in groundwater were studied in an investigation of the natural geologic sources of high concentrations of 226-Ra and 228-Ra in groundwater from wells finished in the Cambrian and Ordovician bedrock in northern Illinois. The combined dissolved concentration of the two isotopes ranges from 2.0 to greater than 50.0 pCi/l. Over 100 public water supplies in northern Illinois exceed the US EPA Interim Drinking Water Standard of 5.0 pCi/l. Most supply wells are over 1000 feet deep and open to receive groundwater from sandstone, dolomite and shale lithologies. The most productive aquifer units, the sandstones, provide the high dissolved radium concentrations. Dissolved concentrations of 222-Rn range from 40.0 to 1000 pCi/l. The combined dissolved concentrations of 238-U and 234-U range from < 0.1 pCi/l to 8.0 pCi/l; concentrations > 1.0 pCi/l reflect marked enrichment in 234-U. Over large regions of northern Illinois groundwater in the Cambrian-Ordovician bedrock is uniquely enriched in 234-U. Dissolved concentrations of 226-Ra are poorly correlated with dissolved concentrations of 238-U, 234-U, 222-Rn and 228-Ra. However, a significant source of dissolved 226-Ra is the chemical precipitation adsorption of the parent 238-U, 234-U and 230-Th nuclides on silica surfaces of the sandstones. A significant source of dissolved 228-Ra is the occurrence of 232-Th-enriched accessory minerals in the sandstone bedrock. The ionic strength of groundwater is an important control on the dissolution of 226-Ra. Mechanisms important to the dissolution of both 226-Ra and 228-Ra are alpha recoil and, in specific localities, the solubility of barite. (See also W88-04980) (Author's abstract)
W88-05004

RADON PRODUCTION IN PUMPING WELLS,
New Mexico Inst. of Mining and Technology, Socorro.
C. S. Chen, and J. L. Wilson.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Appli-

cation to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 423-436, 5 fig, 18 ref.

Descriptors: *Groundwater pollution, *Pumping wells, *Radon, *Wells, *Water pollution sources, Bedrock, Geohydrology, Pumping rate, Groundwater management, Mathematical analysis, Pollutant identification, Geologic fractures.

A simple conceptual model of radon production in wells pumping water from fractured crystalline bedrock was examined analytically. The fracture serves as a radon exposed conduit for 'clean' water originally derived from an overlying layer of saprolite. The analytical solutions provide insight into the nature of radon production, but are not yet adequate for predictive use. In particular, the following specifics were discovered: (1) If the fracture is finite, the radon concentration decreases as the pumping rate increases; (2) If the fracture is finite, the radon concentration increases with the fracture length; (3) If the fracture is effectively infinite, the radon concentration is independent of the pumping rate and of the hydrodynamic dispersion process. In this event, a constant radon concentration exists in the fracture and in the well bore; (4) In general, the radon concentration increases as the radon production rate of the crystalline rock increases, as the dispersivity increases, or as the fracture aperture decreases; and (5) More research is needed to investigate the influence of hydrodynamic dispersion on the radon transport through fractures, and on the complications introduced by accounting for more realistic fracture networks. (See also W88-04980) (Lantz-PTT)
W88-05005

RADIUM-228 AND RADIUM-226 IN GROUND WATER OF THE CHICKIES FORMATION, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Malvern, PA. Water Resources Div.
L. D. Cecil, R. C. Smith, M. A. Reilly, and A. W. Rose.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 437-447, 1 fig, 3 tab, 13 ref.

Descriptors: *Radium radioisotopes, *Groundwater pollution, *Pennsylvania, *Water pollution sources, *Pollutant identification, Quartzite, Radioactivity, Acidic waters, Hydrogen ion concentration, Geohydrology, Water quality, Water supply.

Routine sampling of public water supplies by the Pennsylvania Department of Environmental Resources (PaDER) and the U.S. Environmental Protection Agency (EPA) revealed three supplies in the Chickies Formation that exceeded the EPA drinking water maximum contaminant level (MCL) of 5 pCi/l (picoCuries/liter) dissolved radium. The Chickies Formation, a quartzite, typically forms ridges and borders uplands over an area of 112 sq mi in the Piedmont physiographic province. Thickness ranges from 500 ft near the Delaware River to 950 ft in York County. Reported yields of 100 domestic wells range from 2 to 73 gal/min (gallons per minute) with a median yield of 12.5 gal/min. Total dissolved-solids concentration of the groundwater tends to be low (specific conductance as low as 10 microsiemens per centimeter at 25 C) and pH is acidic (as low as 4.4). The groundwaters are slightly reducing and contain detectable Fe and Mn concentrations. Data from PaDER suggest that the radium anomalies are limited to the Chickies Formation. In these acidic waters, Ra(2+) is probably mobilized and remains in solution rather than being adsorbed as in most groundwater systems. A study being conducted by the U.S. Geological Survey, in cooperation with the Pennsylvania Topographic and Geologic Survey, which includes the sampling of 180 wells completed in or near the Chickies Formation, is expected to characterize the hydrogeology and geochemical environment associated with elevated radium concentrations. Radium-228 concentrations for 48 wells ranged from less than 0.5 to 50 pCi/l, and 226-Ra concentrations ranged from < 0.1 to 9.5 pCi/l. Forty-three of the 48 analyses had 228-Ra concentrations in excess of those for 226-Ra suggesting that gross alpha screening should be used with caution because 228-Ra is not an alpha emitter. (See also W88-04980) (Author's abstract)
W88-05006

HYDROGEOLOGIC CONTROLS ON THE OCCURRENCE OF RADIONUCLIDES IN GROUNDWATER OF SOUTHERN ONTARIO,
Ontario Ministry of the Environment, Toronto.
P. J. Beck, and D. R. Brown.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 449-473, 12 fig, 7 tab, 19 ref.

Descriptors: *Water quality control, *Geohydrology, *Radioisotopes, *Groundwater pollution, *Ontario, Groundwater quality, Radon, Radium, Drinking water, Uranium, Well water.

Groundwater samples from 29 municipal drinking water sources and 137 private supplies were sampled across Southern Ontario and analyzed for the radionuclides; radon (Rn), radium - 226 (226-Ra) and uranium (U). Considering yearly average concentrations, results from all locations sampled fall within Ontario drinking water objectives for 226-Ra and U. Currently, there is no provincial objective for Rn levels in drinking water. Radionuclide concentrations in Southeastern Ontario ranged accordingly: Rn, 0.037-1650 Bq/l (1-44, 600 pCi/l0, 226-Ra, < 37-925 mBq/l (< 1-25 pCi/l) and U, < 3-110 micrograms/l. In Southwestern Ontario, sampling was focused on municipal and private wells which were finished in the Middle Devonian limestone and dolostone of the Detroit River Group which consists of a lower carbonaceous reef facies carbonate overlain by an evaporitic carbonate sequence containing anhydrite. Groundwaters, which recharge through up to 30 m of glacial till with variable amounts of kame moraine and spillway sands, are predominantly CaC02 to CaSO4 in character. Rn levels ranged from 5.18-407 Bq/l (140-11,000 pCi/l), 226-Ra ranged from < 37-680 mBq/l (, 1-18.4 pCi/l), and U concentrations ranged from < 3-39 micrograms/l. Additional samples from 24 domestic wells from elsewhere across the province were sampled. Wells finished in overburden and Middle Ordovician limestone generally contained low radionuclide levels. Samples taken from discrete water bearing horizons within a municipal well show variations in radionuclide concentrations vertically within the stratigraphy. A conceptual model is presented for radionuclide distribution in the Detroit River Group in Southwestern Ontario whereby uranium is mobilized in groundwater under oxidizing conditions. At discrete sites containing carbonaceous material, uranium is reduced and precipitated with the eventual release of Ra and Rn to the groundwater. (See also W88-04980) (Lantz-PTT)
W88-05007

PREDICTIVE MODEL FOR INDOOR RADON OCCURRENCES -- A FIRST APPROXIMATION,
H. E. LeGrand.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 477-487, 1 fig, 7 ref.

Descriptors: *Fate of pollutants, *Radon, *Model studies, *Buildings, *Prediction, Uranium, Geohydrology, Water table, Air pollution, Groundwater level, Topography.

Efforts to develop a model that can allow one to predict the degree of health risks from radon gas emanations in buildings must face intangible factors. Yet, a useful predictive model is needed because: (1) measurements of Rn in millions of buildings are not feasible; (2) variable concentrations of Rn may exist within space and time conditions in a room; and (3) questions of reliability of sampling and analytical procedures arise in many cases. A first approximation toward a predictive model is proposed that applies to the crystalline rock terrane of eastern North America, based on fundamental hydrogeologic factors rather than solely on 'hot-spot' uranium areas. The preliminary model proposed here represents an early approximation of some future improved model that could be more acceptable. This model is based on estimating values (on a 10-point numerical scale) of four factors, as follows: (1) Rock type -- uranium content; (2) Topographic slope and vertical emplacement of building; (3) Hydrogeologic setting and average water-table position; and (4) Water-table behavior and characteristics. The values on compiled and then adjusted more specifically to conditions of indoor construction and ventilation. The final total value is directed to a rating scale that indicates a relative degree of seriousness. Each rated situation is classified as: 'almost certain', 'very likely', 'questionable', 'not likely', or 'very unlikely'. (See also W88-04980) (Lantz-PTT)
W88-05008

ASSESSING THE POTENTIAL WATER QUALITY HAZARDS CAUSED BY DISPOSAL OF RADIUM-CONTAINING WASTE SOLIDS BY SOIL BLENDING,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W88-05010

MODELLING OF TOXIC CONTAMINANTS IN THE NIAGARA RIVER PLUME IN LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
I. Stepien, D. C. L. Lam, C. R. Murthy, M. E. Fox, and J. Carey.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 250-263, 1987. 12 fig, 1 tab, 25 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Chlorinated benzenes, *Coastal waters, *Plumes, *Model studies, *Chlorinated hydrocarbons, *Niagara River, *Lake Ontario, Lakes, Water pollution, Mathematical equations, Chemical partitioning, Coastal physical processes, Pollution load, Wind-driven currents, Water currents, Suspended sediments, Mathematical models, Distribution patterns, Simulation analysis.

The transport and compartmental distribution of chlorinated benzenes in the Niagara bar area were simulated using a two-dimensional model that combines coastal physical processes with a chemical partitioning submodel. The model parameters (partition coefficient, settling velocity) were calibrated with field data and the results compared to observations made in 1983. It was found that the distribution of chlorinated benzenes in the nearshore Niagara region is strongly controlled by the wind-driven field of currents in Lake Ontario and by the amount of suspended sediment contained in the Niagara River plume. The model may be used for the purposes of nearshore and short-time prediction of fate and transport of toxic chemicals in the coastal zone. (Author's abstract)
W88-05029

ORGANIC PRIORITY POLLUTANTS IN NEARSHORE FISH FROM 14 LAKE MICHIGAN TRIBUTARIES AND EMBAYMENTS, 1983,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
J. Camanzo, C. P. Rice, D. J. Jude, and R. Rosemann.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 296-309, 1987. 1 fig, 4 tab, 32 ref. USEPA Grant R005736-01.

Descriptors: *Path of pollutants, *Water pollution effects, *Fish, *Lake Michigan, Polychlorinated biphenyls, Water pollution sources, Fate of pollutants, Pollutants, Tributaries, Toxicity, Hazardous materials, Pesticides, Chromatography, Gas chro-

matography, Bioaccumulation, Tissue analysis, DDT, DDE, Organic compounds, Toxaphene, Carp, Pike, Chlordane.

Composite, nearshore, whole fish samples of selected species, collected in fall 1983 from 13 Lake Michigan tributaries and Grand Traverse Bay, were analyzed for a wide range of pesticides and priority pollutants using gas chromatography-mass spectrometry. Existing source areas for known and previously unrecognized toxic substances were identified. The resident fish with the highest likely levels of contaminants were analyzed. All fish analyzed (eight species from southern Michigan to the upper peninsula) exceeded the 2 milligram/kilogram (mg/kg) FDA action levels for PCBs, while 50% of the samples exceeded the DDTr (DDT-residue) International Joint Commission objective of 1 mg/kg. St. Joseph River common carp (Cyprinus carpio) carried the heaviest contaminant burden of all fish examined for PCBs (27.6 mg/kg), DDTr (10.2 mg/kg), and toxaphene (3.3 mg/kg); chlordane levels (0.85 mg/kg) were second highest to those in the Kalamazoo River common carp (0.87 mg/kg). Concentrations of PCBs, toxaphene, DDT, DDE, and other pesticides were higher in bottom-feeding fish, such as common carp, than in top predators, such as northern pike (Esox lucius). Bottom feeders are relatively fatty fish, and live and feed near contaminated sediments, increasing their potential to bioaccumulate fat-soluble contaminants. Pesticides were also present in elevated concentrations in fish from sites with higher industrial and agricultural development. (Author's abstract)
W88-05032

ADSORPTION AND DESORPTION OF ZN, CU, AND CR BY SEDIMENTS FROM THE RAISIN RIVER (MICHIGAN),
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
T. C. Young, J. V. DePinto, and T. W. Kipp.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 353-366, 1987. 5 fig, 4 tab, 27 ref. USEPA Grant CR810776-01.

Descriptors: *Adsorption, *Desorption, *Path of pollutants, *Heavy metals, *Chemical reactions, *Kinetics, *Sediments, *River sediments, *Raisin River, *Michigan, Copper, Chromium, Zinc, Cations, Model studies, Equilibrium.

Metal adsorption by Raisin River sediments in vitro depended linearly on soluble metal concentration to adsorption densities of 6,000-9,000 micrograms/gram with 48 hour partition coefficients of approximately 50, 30, and 25 liters/gram for Cu, Cr, and Zn, respectively. Partition coefficients computed from field data spanned a comparatively wider range of values in a manner consistent with the often reported adsorbent concentration effect, but other factors likely contributed also. Desorption of Zn was complete and rapid (24-48 hours) in contrast to Cr, which was incomplete and much slower; Cu desorption was intermediate to Zn and Cr. A reversible-resistant equilibrium model could not describe the observations as Cu and Cr did not reach metastable desorption equilibria in 24 days. Metal desorption, however, could be described kinetically by distributing sorbed cations between either of two classes: rapidly desorbing and slowly desorbing cations. Sequential and simultaneous desorption models gave similar predictions. Aqueous chemical considerations suggested precipitated, as well as adsorbed, species could give rise to these observations, but available data did not permit adequate tests of this hypothesis. The extent to which kinetic constraints rather than irreversible reactions account for the desorption-resistant binding signifies a potentially greater metal mobility or bioavailability than would otherwise be assumed. (Author's abstract)
W88-05036

EVALUATION OF THE IMPORTANCE OF TRANSMISSIVITY, HEAD AND CONCENTRATION DATA FOR CONTAMINANT TRANSPORT MODELLING,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
D. Van Rooy.
Nordic Hydrology NOHYBB, Vol 18, No. 3, p 121-150, 1987. 11 fig, 4 tab, 27 ref, append.

Descriptors: *Path of pollutants, *Fate of pollutants, *Groundwater pollution, *Model studies, *Kriging, *Data interpretation, Transmissivity, Head, Pollutant concentrations, Pollutants, Mathematical equations, Mathematical models, Monte Carlo method.

The 3 basic data types of contaminant hydrology were examined by stochastic modelling of a groundwater contamination case. The stochastic transport model, which is of the Monte Carlo type, uses a numerical flow and transport model, and views transmissivity as a random autocorrelated field. A large set of transmissivity realizations was generated using the turning bands technique. Conditioning is done with regard to transmissivity, head and concentration observations. This approach assumes a stationary stochastic process of logtransmissivity. This is implicitly turned into a non-stationary process by the conditioning procedures, which use the kriging uncertainties to determine subsets of realizations that are in agreement with the observations at a predefined confidence level. This approach allows quantification of the uncertainties of predicted head, and concentration through space and time. Conditioning on head observations leaves large transport uncertainties while conditioning on the transmissivity data has a more prominent effect. The single, most effective data type is the concentration data. Smallest transport uncertainties occur when all the data are simultaneously taken into account. The conditioning effect depends on the number and spatial configuration of the data. A trade-off between the stochastic and deterministic transport approach is suggested. In modelling terms this corresponds to a trade-off between advection and dispersion. (Wood-PTT)
W88-05044

SIZE- AND AGE-SPECIFIC PATTERNS OF TRACE METAL CONCENTRATIONS IN FRESHWATER CLAMS FROM AN ACID-SENSITIVE AND A CIRCUMNEUTRAL LAKE,
University of Western Ontario, London. Dept. of Zoology.
S. G. Hinch, and L. A. Stephenson.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 10, p 2436-2442, October 1987. 3 fig, 4 tab, 44 ref.

Descriptors: *Acid rain, *Water pollution effects, *Trace metals, *Clams, *Lakes, *Ontario, Path of pollutants, Fate of pollutants, Mollusks, Canada, Acid-sensitive lakes, Circumneutral lakes, Bioaccumulation, Copper, Cadmium, Tissue analysis, Zinc, Manganese, Heavy metals, Distribution patterns, Acidic water.

Freshwater clams (Elliptio complanata) were collected from an acid-sensitive and a circumneutral lake in south central Ontario and their tissue metal concentrations were compared. Clams from the acid-sensitive lake had higher concentrations of Cu and Cd and lower concentrations of Zn and Mn than clams from the circumneutral lake. Tissue concentrations did not reflect metal levels in the water. Competition may be occurring between metals for binding substrates in clam tissues. Clam size and/or age successfully predicted tissue metal concentrations, but in a metal-specific and tissue-specific manner. Clam biomonitoring studies should therefore control for size and age variability. Lake buffering capability was not very important in influencing size- and age-specific patterns of tissue metal concentrations. However, this conclusion is based solely on data from these two lakes. (Author's abstract)
W88-05051

HYDRAULIC CONDUCTIVITY OF CONTAMINATED NATURAL CLAY DIRECTLY BELOW A DOMESTIC LANDFILL,
University of Western Ontario, London. Faculty of Engineering Science.
R. M. Quigley, F. Fernandez, E. Yanful, T. Helgason, and A. Margaritis.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 3, p 377-383, August 1987. 14 fig, 15 ref. Natural Sciences and Engineering Research Council of Canada, Strategic Support Funds.

Descriptors: *Path of pollutants, *Soil properties, *Waste disposal, *Landfills, *Leakage, *Leachates, *Permeability coefficient, Clays, Domestic wastes, Solute transport, Heavy metals, Sodium compounds, Chlorides, Organic carbon.

The hydraulic conductivity of natural clays in the 1.5 m contamination zone below a 15 year old domestic waste landfill has been determined. Water-soluble contaminants such as chloride, sodium, and dissolved organic carbon have migrated about 1.0 m compared with only 15 cm for copper, zinc, iron, lead, and manganese. The migration, primarily by diffusion, has rendered the clay perfect for assessment of clay-leachate compatibility with respect to hydraulic conductivity, k. Odometer tests on tube samples of the clay yielded k values of 1.4 times 10 to the minus 8th power cm/s with a slight decrease to about 1 times 10 to the minus 8th power cm/s in the upper 20 cm of clay at the waste-clay interface. Direct measurement of k on undisturbed tube samples, reconsolidated to their field stress state and permeated with pore fluid squeezed from adjacent contaminated samples, yielded values of 1.5 times 10 to the minus 8th power cm/s at 1 m depth decreasing to 0.75 times 10 to the minus 8th power cm/s at the interface. The decrease in k near the interface seems to correlate directly with increased pollutant concentration of soluble species, total heavy metal concentration, and a slight decrease in void ratio. The changes in k are so small, however, that for the test leachates and undisturbed test soils at this domestic waste site, it is concluded that the hydraulic conductivity has not changed significantly as a result of contamination. (Author's abstract)
W88-05054

ADAPTATION TO AND BIODEGRADATION OF XENOBIOTIC COMPOUNDS BY MICROBIAL COMMUNITIES FROM A PRISTINE AQUIFER,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. M. Aelion, C. M. Swindoll, and F. K. Pfaender.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 9, p 2212-2217, September 1987. 3 fig, 1 tab, 21 ref. EPA CR-811828.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Microbial degradation, *Soil bacteria, *Bacteria, Biodegradation, Degradation, Mineralization, Adaptation, Aquifers, Chlorinated hydrocarbons, Phenols, Chlorophenol, Ethylene dibromide, Nitrophenol, Aniline, Aminophenol, Cresol, Trichlorobenzene, Chlorobenzene.

The ability of subsurface microbial communities to adapt to the biodegradation of xenobiotic compounds was examined in aquifer solids samples from a pristine aquifer. An increase in the rates of mineralization of radiolabeled substrates with exposure was used as an indication of adaptation. For some compounds, such as chlorobenzene and 1,2,4-trichlorobenzene, slight mineralization was observed but no adaptation was apparent during incubations of > 8 months. Other compounds demonstrated three patterns of response. For m-cresol, m-aminophenol, and aniline intermediate rates of biodegradation and a linear increase in the percent mineralized with time were observed. Phenol, p-chlorophenol, and ethylene dibromide were rapidly metabolized initially, with a nonlinear increase in the percent mineralized with time, indicating that the community was already adapted to the biodegradation of these compounds. Only p-nitrophenol demonstrated a typical adaptation response. In different samples of soil from the same layer in the aquifer, the adaptation period to p-nitrophenol varied from a few days to as long as 6 weeks. In most cases the concentration of xenobiotic added, over the range from a few nanograms to micrograms per gram, made no difference in the response. Most-probable-number counts demonstrated that adaptation is accompanied by an increase in specific degrader numbers. This study has shown

that diverse patterns of response occur in the subsurface microbial community. (Author's abstract)
W88-05061

ABUNDANCE AND DISTRIBUTION OF LEGIONELLACEAE IN PUERTO RICAN WATERS,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
C. M. Ortiz-Roque, and T. C. Hazen.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 9, p 2231-2236, September 1987. 3 fig, 3 tab, 27 ref. PHS Grants RR-2657 and RR-8102, Sea Grant R/LR-08-87-THA1.

Descriptors: *Rivers, *Microbiological studies, *Marine bacteria, *Bacteria, *Puerto Rico, *Legionellaceae, Tropical regions, Wastewater disposal, Wastewater pollution, Food-processing wastes, Rain forests.

Marine and freshwaters in Puerto Rico were analyzed for Legionella spp. by direct fluorescent antibody assay (DFA) with guinea pig confirmation. Mean DFA densities (cells/ml) for the five sampling areas were as follows: L. pneumophila, 47,367; L. gormanii, 15,315; L. micdadei, 12,308; L. longbeachae, 9,620; L. dumoffii, 8,050; L. bozemanii, 4,932; total of all species, 97,592. Mean DFA densities (cells/ml) of all Legionella species at each site were as follows: Mata de La Gata picnic island, 8,925; Boca Vieja Cove, which receives untreated rum distillery effluent, 8,670; Mameyes River watershed, 9,030; Ponce, 14,933; and San Juan, 56,034. Interspecific and intersite variations were significant. Densities of Legionella spp. were highest in sewage-contaminated coastal waters; in fact, they were the highest densities ever reported for marine habitats. L. pneumophila was found at densities of 10-1000 cells/ml in the rain forest in water samples collected between bracts of epiphytic plants growing 9.25 m from the ground. These results suggest that natural aquatic habitats in the tropics are possible reservoirs or sources of Legionella spp. (Cassar-PTT)
W88-05062

TOTAL CARBOHYDRATE: ORGANIC CARBON RATIO AS AN INDICATOR OF SEWAGE-DERIVED ORGANIC MATTER IN BURBO BIGHT SEDIMENTS, LIVERPOOL BAY, UK,
Lancaster Univ. (England). Lancashire and Western Sea Fisheries Joint Committee.
For primary bibliographic entry see Field 5A.
W88-05070

SIMULATION OF DYNAMICS OF DOUBLE-DIFFUSIVE SYSTEM,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-05073

COMPARISON OF INTERNAL PHOSPHORUS LOADS IN LAKES WITH ANOXIC HYPOLIMNIA: LABORATORY INCUBATION VERSUS IN SITU HYPOLIMNETIC PHOSPHORUS ACCUMULATION,
York Univ., North York (Ontario). Faculty of Science.
G. K. Nurnberg.
Limnology and Oceanography LIOCAH, Vol. 32, No. 5, p 1160-1164, September 1987. 2 fig, 4 tab, 10 ref.

Descriptors: *Sediments, *Anaerobic conditions, *Phosphorus, *Lake restoration, Lakes, Hypolimnion, Load distribution, Internal loading.

Phosphorus release rates from anoxic sediments were determined from laboratory incubations of minimally disturbed sediment cores from seven lakes. These release rates were multiplied by an 'anoxic factor,' based on the area and duration of hypolimnetic anoxia, to estimate internal P load. Despite individual variation, the experimentally derived internal loads did not differ significantly from internal loads determined from hypolimnetic P increase at the end of summer stratification, except at internal loads less than 50 mg/sq m/yr. Laboratory release rates can, therefore, help predict internal loads after lake conditions have changed, e.g., after in-lake restoration measures. (Author's abstract)
W88-05095

5C. Effects Of Pollution

HEALTH FEARS CROP IRRIGATION PROMISE,
D. Searle.
Water Resources Journal, No. 152, p 52-53, March 1987. 1 fig.

Descriptors: *Wastewater irrigation, *Wastewater disposal, *Wastewater treatment, *Health effects, *Water pollution effects, Aquaculture, Fish farming, Stabilization ponds, Spray irrigation, Drip irrigation, Furrow irrigation.

Outbreaks of disease have been attributed to irrigation with sewage effluent and even the Jerusalem cholera epidemic in 1970 was traced to vegetables grown on wastewater. More recently, in 1984, Santiago, Chile suffered outbreaks of typhoid and paratyphoid associated with the irrigation of salad crops with river water carrying raw sewage. And yet sewage is a valuable resource in arid areas. One project in Bahrain entails primary, secondary, and tertiary treatment to remove suspended solids and 95% of organic matter. Pathogens are either killed by these processes or by ensuing chlorination and rapid filtration. Injection ozone is being considered as another disinfection precaution. However, the growing opinion among scientists and engineers is that lower quality effluent is acceptable providing its use is carefully regulated so that irrigation is limited to non-edible crops or those which are always cooked before being eaten by human beings. The London School of Hygiene and Tropical Medicine is working in Mexico, India and Indonesia with local engineers, scientists and medics who are setting up projects to monitor the use of sewage in agriculture and fish farms. Other researchers are looking at forms of sewage treatment which can lower risks to health while still being suited to developing countries. Stabilization ponds are a favored low cost technique in which solids and some organic matter settles out. The best methods of irrigation are those which deliver the effluent directly to the growing plant to minimize waste by evaporation and contamination of the surroundings. Drip and furrow irrigation are preferred to flooding fields. Spray methods are particularly undesirable as they can carry dangerous microorganisms several kilometers from the land being farmed. (Lantz-PTT)
W88-04516

TWO OUTBREAKS OF BLASTOMYCOSIS ALONG RIVERS IN WISCONSIN: ISOLATION OF BLASTOMYCES DERMATITIDIS FROM RIVERBANK SOIL AND EVIDENCE OF ITS TRANSMISSION ALONG WATERWAYS,
Wisconsin Univ.-Madison. Center for Health Sciences.
B. S. Klein, J. M. Vergeront, A. F. DiSalvo, L. Kaufman, and J. P. Davis.
American Review of Respiratory Disease ARDSBL, Vol. 136, No. 6, p 1333-1338, December 1987. 1 fig, 2 tab, 30 ref.

Descriptors: *Blastomycosis, *Wisconsin, *Water pollution effects, *Health effects, *Soil Fungi, *Tomorrow River, *Crystal River, Public health, Fungi, Recreation, Soil contamination, Rivers.

Blastomycosis cannot yet be prevented or controlled, in part because the natural habitat of the causative fungus, Blastomyces dermatitidis, remains ill defined. In investigating 2 outbreaks of blastomycosis that occurred in the summer of 1985 among persons engaged in activities along rivers in contiguous central Wisconsin counties, B. dermatitidis was isolated from soil at one of the riverbanks. Blastomycosis developed in 7 (58%) of 12 residents and guests who had gathered at a pheasant farm on the Tomorrow River in early May, and in 7 (88%) of 8 boys and 1 adult who had visited a site on the Crystal River in early June. Of the 14 patients, 13 (93%) were symptomatic. Two patients visiting the sites only once became ill 23 and 78 days after exposure, respectively. One outbreak was traced to fishing from the bank of the Tomorrow River, and the other to climbing into an underground timber fort along the Crystal River. A culture of soil and organic debris from the fishing site yielded B. dermatitidis. From these and other outbreaks, and studies of endemic disease, it is concluded that riverbanks can be a natural habitat of B. dermatitidis, and that the environment around waterways represents the most important site yet identified for the transmission of B. dermatitidis. (Author's abstract)
W88-04555

EFFECTS OF LOW PH AND NICKEL ON GROWTH AND SURVIVAL OF THE SHREDDING CADDISFLY CLISTORONIA MAGNIFICA (LIMNEPHILIDAE),
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
K. Van Frankenhuyzen, and G. H. Geen.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 7, p 1729-1723, July 1987. 1 fig, 4 tab, 25 ref.

Descriptors: *Water pollution effects, *Hydrogen ion concentration, *Nickel, *Caddisflies, Toxicity, Nickel chloride, Lethal limits, Growth, Survivgal, Larvae.

In laboratory experiments with larvae of the shredding caddisfly Clistoronia magnifica, toxicity of nickel chloride hexahydrate was highly pH dependent. Larvae were exposed from first instar until pupation to three nickel concentrations (55, 215 700 micrograms Ni(2+)/l) in soft water adjusted to pH 4.1, 5.5, and 6.2. Nickel reduced the survival of larvae and pupae at all pH levels but toxicity decreased with increasing H(+) concentration. In addition, Ni at 215 micrograms/l temporarily ameliorated H(+) toxicity to early instar larvae at pH 4.1. Reduced toxicity with decreasing pH fits the hypothesis that free metal ions compete with H(+) for the same binding-uptake sites. Available data suggest that this phenomenon is not restricted to a particular metal or organism but that it applies to pH-metal interactions in general. (Author's abstract)
W88-04559

STATUS OF HEADWATER BENTHIC INSECT POPULATIONS IN AN AREA OF HIGH HYDROGEN ION AND SULFATE DEPOSITION,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
W. E. Sharpe, T. G. Perlic, W. M. Tzilkowski, and W. G. Kimmel.
Northeastern Environmental Science NOESDE, Vol. 6, No. 1, p 23-30, 1987. 3 fig, 4 tab, 13 ref.

Descriptors: *Benthic environments, *Insects, *Hydrogen ion concentration, *Sulfates, *Acid rain, Ecological effects, Streams, Pennsylvania, Laurel Hill, Headwaters, Alkalinity, Acidic waters, Population distribution, Species diversity.

The benthic insect communities of eleven headwater streams on the Laurel Hill in southwestern Pennsylvania were studied to determine their status. The streams represented classes of total alkalinity and acidification status present in the area. Total numbers and total taxa present were not useful in determining acidification status except to indicate those streams that were most seriously acidified. The ratio of Ephemeroptera taxa present to Diplera taxa presennt acidification status and total alkalinity for the relevent streams. Acidification, presumably as a result of atmospheric deposition, has adversely impacted benthic insect communities on Pennsylvania's Laurel Hill. Where stream acidification is greatest, many benthic insect taxa have been eliminated. (Author's abstract)
W88-04560

POTENTIAL AND ACTUAL BIOLOGICAL RELATED HEALTH RISKS OF WASTEWATER INDUSTRY EMPLOYMENT,
Cincinnati Univ., OH. Dept. of Environmental

Health.
C. S. Clark.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 999-1008, December 1987. 4 tab, 69 ref.

Descriptors: *Water pollution effects, *Health effects, *Wastewater facilities, *Infection, Personnel, Hepatitis, Parasites, Viruses, Bacteria, Acquired immune deficiency syndrome, Risk analysis, Microbiological studies.

Wastewater workers have long been known to be exposed to many disease-producing microbial agents routinely discharged in sewers from hospitals and throughout the community from persons with illnesses caused by those agents as well as carriers. Although most studies indicate that infections with specific agents are not common, wastewater-exposed workers, especially during their first few years of employment, experience increased rates of gastrointestinal illness, which is generally thought to be related to biological exposures. Two studies indicated a risk of hepatitis A among sewer workers and those involved in primary sludge treatment. Recent studies have shown sewer workers to be at increased risk of parasitic infection but improved work practices seemed to reduce the risk. In studies where there were indications of increased risk to viral and/or bacterial agents it was frequently only the most heavily exposed subgroup of workers experiencing the increased risk. Appropriate work practices including facilities for daily showers and separation of clothing used on the job and after work are essential. Use of personal protective equipment and practices recommended for health care workers to prevent infection from the virus causing acquired immune deficiency syndrome (human immunodeficiency virus) is advised and as much as feasible by those exposed to wastewater such as in and near hospitals. (Lantz-PTT)
W88-04582

IMPACTS OF ACID ATMOSPHERIC DEPOSITION ON WOODLAND SOILS IN THE NETHERLANDS: I. CALCULATION OF HYDROLOGIC AND CHEMICAL BUDGETS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
J. J. M. Van Grinsven, N. Van Breemen, and J. Mulder.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1629-1634, November-December 1987. 4 fig, 5 tab, 21 ref. EEC Grant No. ENV 650-NL.

Descriptors: *Acid rain, *Water pollution effects, *Forests, *Soil chemistry, *Netherlands, *Hydrologic budget, Solute transport, Variability, Forest watersheds, Soil water, Permeability coefficient, Evapotranspiration, Chemical analysis, Aluminum, Nitrates, Hydrogen ion concentration, Mathematical models.

To study effects of acidic atmospheric deposition on woodland soils in the Netherlands, chemical budgets were determined from simulated water fluxes and measured soil solution concentrations. Solute concentrations were determined in soil solutions that were sampled monthly over a 3-yr period at various depths in four different soils. Soil-water fluxes were calculated with the SWATRE model. Rainfall and canopy troughfall were measured at the study site. Potential evapotranspiration was estimated by an adapted Penman method. Hydraulic conductivity was calculated from the soil-water retentivity curves according to the Van Genuchten method. Simulated pressure heads could be fitted to field observations after reduction of conductivities by a factor between 6 and 60. Coefficients of variation for chemical budgets were determined by sensitivity analysis of the simulated soil-water flux, and by measuring spatial, temporal, and analytical variability of the solute concentrations. Coefficients of variation of solute fluxes for Al and NO3 ranged from 10 to 30% between the 10- and 90-cm depth, with spatial variability as the most important source of uncertainty. Coefficients of variation of chemical budgets (difference between inputs and outputs of solutes) for soil compartments that include the soil surface were also 10 to 30%, whereas those for deeper soil layers were larger, ranging from 40 to 200%. (See also W88-04652 and W88-04653) (Author's abstract)
W88-04651

IMPACTS OF ACID ATMOSPHERIC DEPOSITION ON WOODLAND SOILS IN THE NETHERLANDS: II. NITROGEN TRANSFORMATIONS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
N. Van Breemen, J. Mulder, and J. J. M. Van Grinsven.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1634-1640, November-December 1987. 2 fig, 4 tab, 35 ref. EEC Grant No. ENV 650-NL.

Descriptors: *Acid rain, *Water pollution effects, *Forests, *Soil chemistry, *Netherlands, *Hydrologic budget, Solute transport, Forest watersheds, Soil water, Permeability coefficient, Evapotranspiration, Nitrification, Chemical analysis, Aluminum, Nitrates, Hydrogen ion concentration.

Inorganic N budgets were estimated for four oak-birch (Quercus robur L.-Betula pendula L.) woodland soils in the Netherlands, that receive high inputs (40-60 kg/ha/yr) of atmospheric N, mainly as (NH4)2SO4. Budgets were based on measured inputs in throughfall water, measured soil solution concentrations, and simulated soil-water fluxes. Substantial nitrification occurred in both highly acidic (pH 3-4) and calcareous (pH 6.5-7.5) soils. The acidity formed during N transformations (3-9 kmol/ha/yr) accounted for a major part of all soil acidification taking place. Extreme soil acidification due to nitrification (4-14 kmol/ha/yr) accounted for a major part of all soil acidification taking place. Extreme soil acidification due to nitrification (4-14 kmol/ha/yr) in the 10-cm surface soil in three of the four plots was partly alleviated at greater depth by removal of NO3(-). Presumably, most of this NO3(-) was removed by plants and microorganisms and, perhaps, in part by denitrification. In two of the four soils, leaching of inorganic NO3(-) exceeded atmospheric throughfall input. This trend indicates that N inputs were still higher, e.g., due to direct assimilation of atmospheric NH3 by tree leaves, or that the pool of soil N decreased by mineralization in excess of uptake. In one of the four soils, most of the atmospheric N2 was assimilated and soil acidification due to N transformations was relatively small. The differences in N budgets and associated soil acidification may be related to: (i) consistent differences in N input over many years, and (ii) differences in accumulation of N in biomass. Variation in these two factors may be responsible for differences in the degree to which the ecosystems are now 'saturated' with N. (See also W88-04651 and W88-04653) (Author's abstract)
W88-04652

IMPACTS OF ACID ATMOSPHERIC DEPOSITION ON WOODLAND SOILS IN THE NETHERLANDS: III. ALUMINUM CHEMISTRY,
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology.
J. Mulder, J. J. M. Van Grinsven, and N. van Breemen.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 6, p 1640-1646, November-December 1987. 3 fig, 5 tab, 30 ref. EEV Grant No. ENV-650-NL.

Descriptors: *Acid rain, *Water pollution effects, *Forests, *Soil chemistry, *Netherlands, *Hydrologic budget, Solute transport, Forest watersheds, Soil water, Permeability coefficient, Evapotranspiration, Chemical analysis, Aluminum, Nitrates, Hydrogen ion concentration, Sulfates.

Annual element budgets for three acidic oak-birch (Quercus robur L.-Betula pendula L.) woodland soils in the Netherlands indicate high inputs of atmospheric (NH4)2SO4 (2.35-3.45 kmol NH4/ha/yr). Nitrogen transformations lead to strong acid inputs of 3.0 to 7.5 kmol/ha/yr in these soils, which are neutralized primarily by solubilization of Al in the surface 20-cm mineral layers (3-7 kmol/ha/yr). Aluminum was hypothesized to be relatively important in neutralizing strong acid inputs, due to the high acid loading and the low content of base cations. At the low pH (pH 3.27-4.26) dissolved Al in the mineral soil was mainly in aquo-Al(3+) form. Highest Al concentrations (up to 4 mol/cu m) were reached in summer and coincided with high NO3(-) concentrations. In winter and spring, the export of Al with drainage water peaked and solute concentrations decreased. All Al mobilized in the surface layers of soil A was retained below the 40-cm depth, probably due to cation exchange, since below this depth base saturation increased. In the deeper horizons of soils B and C, immobilization of Al was less, probably because base saturation was low. All subsoil solutions were undersaturated with respect to gibbsite and near equilibrium with jurbanite. Formation of jurbanite is unlikely, however, because mass balance calculations do not indicate net SO4 retention. (See also W88-04651 and W88-04652) (Author's abstract)
W88-04653

GREAT LAKES CLEANUP EFFORT: MUCH PROGRESS, BUT PERSISTENT CONTAMINANTS REMAIN A PROBLEM,
For primary bibliographic entry see Field 5G.
W88-04659

CONTAMINATED DRINKING WATER AS A POTENTIAL CAUSE OF CANCER IN HUMANS,
International Agency for Research on Cancer, Lyon (France).
J.P. Velema.
Journal of Environmental Science and Health JECREO, Vol. C5, No. 1, p 1-28, 1987. 4 tab, 73 ref.

Descriptors: *Contamination, *Carcinogens, *Risks, *Human diseases,*Public Health, *Drinking Water, *Domestic Water, Epidemiology, Hydrocarbons, Asbestos, Nitrates, Trace metals, Radioisotopes.

The author examines five broad categories of contaminants, discussing known carcinogenicity and reviewing epidemiological studies of each contaminant to evaluate whether consumption of water contaminated with each group is associated with an increased risk of cancer and to estimate the magnitude of risk suggested by the human evidence. Reviewed categories include halogenated hydrocarbons, asbestos, nitrate, trace metals, and radioactive isotopes. With few exceptions, the relative risk of cancer associated with human exposure to contaminated drinking is small. If a public health risk exists, it lies in the fact that vast numbers of people are exposed for long periods of time. (Friedmann-PTT)
W88-04660

LITERATURE REVIEW OF THE EFFECTS OF PERSISTENT TOXIC SUBSTANCES ON GREAT LAKES BIOTA,
Beak Consultants Ltd., Mississauga (Ontario).
J. Fitchko.
Report of the Health of Aquatic Communities Task Force, December 1986. 255 p, 1 fig, 12 tab, 1080 ref.

Descriptors: *Literature reviews, *Toxicity, *Hazardous wastes, *Toxic wastes, *Great Lakes, *Water pollution effects, *Bioaccumulation, Environmental effects, Health effects, Drinking water, Research priorities, Ecosystems, Aquatic environment, DDE, Fish, Lead, Organic compounds, Pesticides, Hydrocarbons.

In assessing the potential effects of persistent toxic substances on the health of Great Lakes biota, it is important to recognize that virtually all species have evolved systems for extracting and concentrating trace elements and compounds from their natural environment. This natural process and its ability to bioconcentrate and regulate cycling of certain elements and compounds is absolutely es-

sential to the survival of all life on earth. The concentration range for normal metabolic functioning appears to be related to trophic level and habitat and varies considerably species. The following conclusions can be drawn from the studies reviewed here: (1) few studies have been undertaken to assess the effects of specific persistent toxic substances on the structural and functional responses of Great Lakes biota; (2) insufficient research has been undertaken to permit assessment of human health consequences of exposure to Great Lakes drinking water and contaminated fish; (3) most of the research is recent; (4) only a small number of specific persistent toxic substances have been assessed by in situ or laboratory studies; (5) generally few, and in some cases, no studies have been undertaken to assess the effects of specific persistent toxic substances on the health of aquatic biota in the 42 Areas of Concern; and (6) four physiological response tests appear to be available to assay the effects of specific persistent toxic substances or classes of contaminants; these are beta-amino levulinic acid dehydratase induction in fish by lead, aryl hydrocarbon hydroxylase induction in a number of organisms by PAHs, eggshell thinning in birds by DDE, and increased porphyrin levels in liver of birds due to organochlorine pesticides. (Lantz-PTT)
W88-04726

HYDROLOGY AND POLLUTANT REMOVAL EFFECTIVENESS OF WETLAND BUFFER AREAS RECEIVING PUMPED AGRICULTURAL DRAINAGE WATER,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
G. M. Chescheir, J. W. Gilliam, R. W. Skaggs, R. G. Broadhead, and R. Lea.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128061/AS. Price codes: A06 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Report No. 231, August 1987. 170 p, 47 fig, 13 tab, 22 ref.

Descriptors: *Agricultural runoff, *Wetland buffers, *Wetlands, *Swamps, *Pumped agricultural drainage, *Surface drainage, *North Carolina, Water quality, Drainage effects, Drainage ditches, Nutrients, Sediment loading, Tidewater region, DRAINMOD model.

The hydrology and pollutant-removing effectiveness of two wetland areas being used to buffer impacts of pumped agricultural drainage in Eastern North Carolina were studied. Collection and analysis of field data over a two-year period showed that buffer one, originally equipped with an efficient diffuser canal, was essentially 100% effective for pollutant removal for all observed events. Less effective flow distribution, less area and faster drainage resulting from a greater elevation at buffer two resulted in less effective removal. Hydrology of a buffer area was simulated with a wetland simulation model for overland flow through vegetated areas. A routine was added to calculate residence time of the water on the buffer and percent removal of nutrients. Hourly surface and subsurface field drainage volumes calculated by a water management model. The two models estimated that over a 20-year period, study buffer one would remove 79% of total Kjeldahl nitrogen, 82% of nitrate nitrogen, 81% of total phosphorus, and 92% of sediment. Study of the response of wetland forest to pumped agricultural drainage showed pronounced overstory thinning and resultant increased floor regeneration, decreased plant diversity, and decreased annual tree diameter increment at buffer one, and decreased annual tree diameter at buffer two. (Lambert-UNC-WRRI)
W88-04742

ORGANIC COMPOUND EFFECTS ON SWELLING AND FLOCCULATION OF UPTON-MONTMORILLONITE,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W88-04759

MEASUREMENT OF PROTEOLYSIS IN NATURAL WATERS AS AN APPROACH TO THE STUDY OF NATURAL CYCLING AND POLLUTION IMPACT,
Vermont Univ., Burlington. Dept. of Microbiology and Biochemistry.
For primary bibliographic entry see Field 5A.
W88-04764

COMPARATIVE SURVIVAL AND INJURY OF CANDIDA ALBICANS AND BACTERIAL INDICATOR ORGANISMS IN STREAMS RECEIVING ACID MINE DRAINAGE,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5A.
W88-04854

PHYTOPLANKTON BIOMASS AND PRODUCTION IN THE RIVER MEUSE (BELGIUM),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium).Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-04858

SURVIVAL OF SPOTTED SALAMANDER EGGS IN TEMPORARY WOODLAND PONDS OF COASTAL MARYLAND,
Patuxent Wildlife Research Center, Laurel, MD.
P. H. Albers, and R. M. Prouty.
Environmental Pollution EPEDB7, Vol 46, No. 1, p 45-61, 1987.3 tab, 48 ref.

Descriptors: *Water pollution effects, *Ponds, *Acid rain, *Salamanders, *Eggs, Intermittent lakes, Maryland, Spotted salamanders, Ambystoma maculatum, Hydrogen ion concentration, Magnesium, Chlorophyll, Water chemistry, Amphibians, Oxygen requirements, Rainfall, Phytoplankton, Zooplankton, Water temperature, Temperature, Aluminum, Magnesium.

Temporary ponds on the Atlantic Coastal Plain in Maryland were characterized according to water chemistry, rain input, phytoplankton, zooplankton and use by the spotted salamander Ambystoma maculatum during March-October 1983-84. Neither the number of egg masses per unit of pond surface (abundance) nor the survival of spotted salamander embryos was significantly correlated ($P>0.05$) with pond pH. Rainfall during May-July significantly increased the hydrogen ion concentration of 5 of 11 ponds evaluated for the impact of rainfall during the previous 48 hours and the previous week. Survival of egg masses transferred among eight ponds with pH 3.66-4.45, and one pond with pH 5.18 was significantly reduced only at pH 3.66. Embryonic survival was negatively correlated with the concentration of aluminum in the pond water. The abundance of egg masses was positively correlated with water temperature and magnesium concentration, and total chlorophyll during the larval period. Yearly variability of pond characteristics (e.g., water chemistry, pond longevity) and amphibian reproduction make it difficult to determine the effects of acidic deposition on the spotted salamander. At the present time, pond longevity, water temperature and possible oxygen content seem more important to spotted salamander reproduction than chemical changes caused by annual acidic deposition. (Author's abstract)
W88-04869

RADON, RADIUM AND OTHER RADIOACTIVITY IN GROUND WATER: HYDROGEOLOGIC IMPACT AND APPLICATION TO INDOOR AIRBORNE CONTAMINATION.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5B.
W88-04980

PRELIMINARY ASSESSMENT OF FACTORS AFFECTING RADON LEVELS IN IDAHO,
Tennessee Technological Univ., Cookeville. Water Resources Center.
For primary bibliographic entry see Field 5B.
W88-04986

ORGANIC PRIORITY POLLUTANTS IN NEARSHORE FISH FROM 14 LAKE MICHIGAN TRIBUTARIES AND EMBAYMENTS, 1983,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5B.
W88-05032

RELATIONSHIP BETWEEN CARBON, NITROGEN AND CHLOROPHYLL A IN THE RIA OF PONTEVEDRA, NW OF SPAIN (RELACIONES ENTRE CARBONO, NITROGENO Y CLOROFILA A EN LA RIA DE PONTEVEDRA, NO DE ESPANA),
Instituto de Investigaciones Marinas, Vigo (Spain).
F. G. Figueiras, and F. X. Niell.
Investigacion Pesquera IPESAV, Vol. 51, No. 1, p 3-21, March 1987. 4 fig, 1 tab, 26 ref.

Descriptors: *Water pollution *Nutrient cycling, *Carbon, *Nitrogen, *Chlorophyll a, *Ria de Pontevedra, Fate of pollutants, Regression analysis, Mathematical studies, Spain, Nutrients, Statistical analysis, Chemical analysis, Phytoplankton, Pulp and paper industry.

Regression analysis is inadequate to establish carbon:nitrogen (C/N) and chlorophyll a:carbon (Chl/C) ratios in the Ria de Pontevedra, due to the existence of three groups of data which cannot be separated a priori, as in the method employed for the ocean. Nevertheless, the wastes of the paper industry (ENCESA) are easily identified by their higher C/N ratios. In the rest of the river, the C/N and Chl/C ratios are as expected for growing phytoplankton populations and for decaying matter. The Chl/C ratios are more variable than the C/N ratios, however, the values reported are in agreement with those expected for an annual cycle. It is noteworthy that, in situations where nitrates are totally depleted, the C/N ratios do not reach the value of 15. This suggests that nutrient remineralization in surface waters may be important. The role played by the offshore pycnocline in fertilization of the river is discussed. (Author's abstract)
W88-05039

ALGAL AND BACTERIAL ACTIVITIES IN ACIDIC (PH 3) STRIP MINE LAKES,
Purdue Univ., Lafayette, IN. Dept. of Biological Sciences.
R. A. Gyure, A. Konopka, A. Brooks, and W. Doemel.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 9, p 2069-2076, September 1987. 10 fig, 6 tab, 39 ref.

Descriptors: *Water pollution effects, *Lakes, *Strip mine lakes, *Acidic water, *Algae, *Bacteria, Mine drainage, Nutrients, Oligotrophic lakes, Anaerobic conditions, Sediments, Lake sediments, Hydrogen sulfide, Hydrogen ion concentration, Chlorophyll, Mineralization.

Two highly acid lakes in the Greene-Sullivan State Forest near Dugger, Indiana, were sites for the study of chemical characteristics and capacity for organic production and mineralization: Reservoir 29 (epilimnion pH of 2.7) and Lake B (epilimnion pH of 3.2). In Reservoir 29 the pH of the profundal sediments increased from 2.7 to 3.8 during thermal stratification. This rise was correlated with a temporal increase in hydrogen sulfide concentration in the anaerobic hypolimnion from 0 to >1 mM. In Lake B the permanently anoxic sediments had a pH of 6.2. Chlorophyll a levels in the epilimnion were low, and the rate of primary production was typical of an oligotrophic lake. At the bottom of the metalimnion was a dense 10-cm layer of algal biomass. Production by this layer was low because of light limitation and possible hydrogen sulfide toxicity. Specific photosynthetic rates of epilimnetic algae were low, suggesting that nutrient availability may be more important than pH as a limiting factor. Heterotrophic bacterial activity was greatest at the sediment/water interface. Bacterial production in Reservoir 29 was typical of that in a nonacid mesotrophic lake. (Cassar-PTT)

W88-05058

ASSESSING THE IMPLICATIONS OF ENVIRONMENTAL CHANGE FOR AGRICULTURAL PRODUCTION: THE CASE OF ACID RAIN IN ONTARIO, CANADA,
Guelph Univ. (Ontario). Dept. of Geography.
L. Ludlow, and B. Smit.
Journal of Environmental Management JEVMAW, Vol. 25, No. 1, p 27-44, July 1987. 3 fig, 2 tab, 40 ref.

Descriptors: *Water pollution effects, *Acid rain, *Agriculture, *Ontario, *Crop yield, Farming, Crop production, Vegetables, Grain crops, Fruit crops, Beans, Corn, Hay, Oats, Barley, Potatoes, Tobacco, Wheat, Apples, Grapes, Peaches, Peas, Tomatoes.

Two scenarios were developed to estimate the impacts of acid rain on agricultural production in Ontario. For Scenario 1 it was assumed that rain acidities will decrease from current levels to pH of 5-6 (considered nonpolluted with respect to acid). For Scenario 2 it was assumed that rain acidities will increase from current levels. Then, the impact of acid rain on selected crop yields was determined from a review of existing experimental data. Finally, the yield response estimates were applied to assess the impacts of acid rain on regional agricultural production and production potential in Ontario. Results reveal that impacts on agricultural production and production potential are relatively small. The present crop loss due to acid rain is 2% of the total production or $43 million. Increased acidity under Scenario 2 would produce little change in crop production from the present situation. However, yields of some crops (grain corn and fodder corn) improve with increased acidity. If rain were unpolluted as in Scenario 1, the greatest improvement in crop production would be noted in the south and southwest portions of the province, except for Haldimand-Norfolk County, a tobacco-producing region. (Cassar-PTT)
W88-05064

EFFECTS OF ROADSIDE SNOWMELT ON WETLAND VEGETATION: AN EXPERIMENTAL STUDY,
Ottawa Univ. (Ontario). Dept. of Biology.
P. S. Isabell, L. J. Fooks, P. A. Keddy, and S. D. Wilson.
Journal of Environmental Management JEVMAW, Vol. 25, No. 1, p 57-60, July 1987. 1 fig, 1 tab, 23 ref.

Descriptors: *Water pollution effects, *Wetlands, *Snowmelt, *Roads, *Salt, *Vegetation, Aquatic vegetation, Runoff, Marshes, Germination, Seeds, Deicers.

Germination and growth of wetland plant seeds were studied after application of roadside snowmelt at concentrations of 100% and 20%, using tap water as a control. Only two species, Typha latifolia and Lythrum salicaria, germinated in plants watered with 100% roadside snowmelt. Germination in seeds watered with 20% snowmelt was 2-19.2%, depending on variety, compared with 5.8-30% with the control water. After one month of growth, community biomass, species diversity, evenness and richness all decreased significantly with increasing snowmelt concentration. (Cassar-PTT)
W88-05065

IMPACT OF ATRAZINE ON LAKE PERIPHYTON COMMUNITIES, INCLUDING CARBON UPTAKE DYNAMICS USING TRACK AUTORADIOGRAPHY,
National Museums of Canada, Ottawa (Ontario). Botany Div.
P. B. Hamilton, G. S. Jackson, N. K. Kaushik, and K. R. Solomon.
Environmental Pollution EPEBD7, Vol. 46, No. 2, p 83-103, 1987. 5 fig, 4 tab, 53 ref.

Descriptors: *Water pollution effects, *Lakes, *Atrazine, *Algae, Aquatic habitats, Habitats, Periphyton, Chlorophyll, Cyanobacteria, Chlorophyta, Herbicides, Pesticides.

Chlorophyll a, freshweight biomass, ash-free dry weight, cell numbers, species richness, community carbon uptake and species-specific carbon uptake were used to monitor the impact of atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) on an in situ, enclosed periphyton community. Atrazine concentrations ranging from 0.08 to 1.56 mg/liter were used during the 2 years of study. In both 1982 and 1983, there was a shift from a chlorophyte- to a diatom-dominated community. In 1982 the cyanobacterium Cylindrospermum stagnale and the chlorophyte Tetraspora cylindrica developed isolated colonies in the 1.56 mg/liter treatment, indicating resistance to atrazine at this concentration. After atrazine exposure, community productivity was reduced by 21% to 82% in the low to high exposures, respectively. After day 21 productivity returned to control levels. It was shown, using track autoradiography, that the productivities of the large algae Mougeotia sp., Oedogonium sp., Tolypothrix limbata and Epithemia turgida were the most affected, with reductions of 74.3% to 93.1% that of the controls. All the biotic measures indicated reduced growth after herbicide exposure (Author's abstract)
W88-05069

IMPACT OF ANGLER GROUNDBAIT ON BENTHIC INVERTEBRATES AND SEDIMENT RESPIRATION IN AN SHALLOW EUTROPHIC RESERVOIR,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
M. Cryer, and R. W. Edwards.
Environmental Pollution EPEBD7, Vol. 46, No. 2, p 137-150, 1987. 3 fig, 2 tab, 25 ref.

Descriptors: *Water pollution effects, *Lakes, *Fishing, *Baits, *Invertebrates, Benthic invertebrates, *Eutrophic lakes, Reservoirs, Oxygen consumption, Fish food, Sediments, Lake sediments, Degradation, Microbial degradation.

Cereal or maggots were added to areas of sediment in a small, shallow eutrophic reservoir at the rate of 0.4 and 4.0 kg/sq m of cereal or 0.22 liters/sq m of maggots over a 12-week period. The higher cereal loading reflected very intensive fishing, and the lower cereal loading and maggot application reflected normal fishing density. The densities of benthic invertebrates were reduced by cereal baiting, the most sensitive being naidid worms and cladocerans; the tubificid Limnodrilus hoffmeisteri was not affected. Recovery in the benthic community was not apparent after 4 months, although cyclopoid copepods were significantly more abundant in cereal-treated areas. Maggot baiting produced results of the same order. Laboratory studies of oxygen consumption in the sediments showed that oxygen consumption increased with increasing cereal loading up to a factor of 100 for the highest application rate of 1.6 kg/sq m. The results of the rapid (within 2 weeks at summer temperatures) breakdown of groundbait are reduction in the benthic invertebrate population and intermittent severe deoxygenation, especially under warm, calm conditions, making further fishing unproductive. (Cassar-PTT)
W88-05071

SEASONAL AND LONGITUDINAL VARIATIONS IN APPARENT DEPOSITION RATES WITHIN AN ARKANSAS RESERVOIR,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. F. James, R. H. Kennedy, R. H. Montgomery, and J. Nix.
Limnology and Oceanography LIOCAH, Vol. 32, No. 5, p 1169-1176, September 1987. 8 fig, 1 tab, 14 ref.

Descriptors: *Sedimentation, *Reservoirs, *Turbidity, Chlorophyll a, Hypolimnion, Oxygen depletion, Organic carbon, Detritus, Lakes, Sedimentation basins, Arkansas.

Seasonal and spatial differences in apparent sediment trapping rates were related to the establishment of longitudinal gradients in water quality at DeGray Lake, Arkansas. Gradients in turbidity developed during winter and spring due to suspended loads, which settled primarily in the headwater region. Gradients in apparent deposition of allochthonous organic carbon and chlorophyll a also influenced detrital processing and hypolimnetic dissolved oxygen conditions. Hypolimnetic dissolved oxygen depletion started in May in the headwater region, due to a high volumetric dissolved oxygen demand, and spread slowly to the dam by winter. These patterns indicated that riverine inputs and deposition influenced biological activity along the longitudinal axis of the lake. (Author's abstract)
W88-05097

ALKALINITY DYNAMICS IN AN UNACIDIFIED ALPINE LAKE, SIERRA NEVADA, CALIFORNIA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W88-05102

FIELD EXPERIMENT ON THE INFLUENCES OF SUSPENDED CLAY AND P ON THE PLANKTON OF A SMALL LAKE,
Shaw Univ., Raleigh, NC. Dept. of Biology.
B. E. Cuker.
Limnology and Oceanography LIOCAH, Vol. 32, No. 4, p 840-847, July 1987. 6 fig, 2 tab, 34 ref. University of North Carolina Water Resources Research Institute Grant 40041, EPA Grant R813315-01-0.

Descriptors: *Water pollution effects, *Limnology, *Suspended sediments, *Phosphorus, *Aquatic productivity, *Chlorophyll a, *Algae, Zooplankton, Lakes, Limnocorrals, Pollution loading, Kaolinite, Turbidity, Secchi disks, Flagellates.

Independent and interactive effects of P and clay loading on pelagic community organization and productivity were tested in Durant Lake, a small lake on the North Carolina piedmont. Twelve limnocorrals were employed. Treatments (in triplicate) were: unaltered controls, P loading of 3.3 mg/sq m/day, kaolinite clay loading of 100 g/sq m/day, and combined clay and P loading. P loading significantly increased rates of turbidity reduction (Secchi depth increasing at 7.2 vs 5.8 cm/day for control) and significantly lowered sustained turbidity in treatments under clay loading. Clay loading reduced net community productivity (NCP), Chl a concentrations, and algal cell numbers. In response to suspended clay loading Trachelomonas superba and other flagellates replaced the otherwise dominant Spirulina major. Fertilization with P increased NCP and algal densities and favored development of nitrogen fixers Anabaena spiroides and A. circinalis. Combined P and clay loading produced intermediate values of turbidity, NCP, and Chl a. Simultaneous clay loading eliminated the influence of P fertilization on algal community structure, yielding an assemblage dominated by flagellates. Clay turbidity also caused a shallowing in the daytime distribution of zooplankton. (Author's abstract)
W88-05103

5D. Waste Treatment Processes

ACIDOGENIC DEGRADATION OF THE NITROGEN FRACTION IN VINASSE,
Centro de Investigazcion de Standard Electrica S.A., Madrid (Spain). Inst. de Fermentaciones Industriales.
M. Gil-Pena, M. J. Gutierrez, E. Amo, and I. Schnabel.
Biotechnology Letters BILED3, Vol. 9, No. 8, p 587-592, August 1987. 2 fig, 4 tab, 10 ref.

Descriptors: *Wastewater treatment, *Vinasse, *Nitrogen, Biodegradation, Chemical oxygen demand, Ammonia, Fatty acids.

In an earlier paper, 60-70% of the chemical oxygen demand (COD) in vinasse was found to be broken down to volatile fatty acids (VFAs) during acidogenesis. Thus, from 30 to 40% of the COD may be unaltered at the end of the process. The ammonia

nitrogen (N-NH4(+)) concentration in the effluent was also reported to be about one-third of the initial total nitrogen in the vinasse. It was therefore concluded that approximately two-thirds of the total nitrogen did not undergo degradation during the optimum hydraulic retention time (HRT) for acidogenesis, which was found to be eight hours. Degradation of the nitrogen fraction in sugar beet vinasse during continuous acidogenesis was studied. The total nitrogen content in the vinasse was approximately 4 g/L, with only traces of ammonia nitrogen. During acidogenesis N-NH4(+) increased proportionately to the breakdown of betaine and amino acids. (Lantz-PTT)
W88-04505

TEMPERATURE, PH, AND CATIONS AFFECT THE ABILITY OF ESCHERICHIA COLI TO MOBILIZE PLASMIDS IN L BROTH AND SYNTHETIC WASTEWATER,
Drexel Univ., Philadelphia, PA. Dept. of Bioscience and Biotechnology.
T. A. Khalil, and M. A. Gealt.
Canadian Journal of Microbiology CJMIAZ, Vol. 33, No. 8, p 733-737, August 1987. 4 fig, 1 tab, 21 ref. EPA Grant No. R812362.

Descriptors: *Biological communities, *Wastewater treatment, *Escherichia coli, Temperature, Hydrogen ion concentration, Plasmids, Salts, Detergents.

Coincubations of plasmid donor and recipient cells in L broth and in synthetic wastewater demonstrated that a large number of environmental factors must be taken into account when measuring the potential for the dissemination of plasmid-encoded genes in natural environments. These include salts and detergents in the medium as well as other factors, e.g., pH and temperature. Complex interactions between and among agents were observed, indicating that simple additive effects may not be assumed. Mobilization of genetically engineered nonconjugative plasmid pHSV106 was inhibited by the same compounds that affected conjugative plasmid movement. (Author's abstract)
W88-04506

SELECTION AND ADAPTATION OF A PHENOL-DEGRADING STRAIN OF PSEUDOMONAS,
Barcelona Univ. (Spain). Dept. d'Enginyeria Quimica i Bioquimica.
C. Masque, M. Nolla, and A. Bordons.
Biotechnology Letters BILED3, Vol. 9, No. 9, p 655-660, September 1987. 1 fig, 2 tab, 24 ref. Spanish Oil Company Grant No. EMP-1985-1986.

Descriptors: *Biological wastewater treatment, *Phenols, *Pseudomonas, Bacteria, Biodegradation, Wastewater treatment, Activated sludge, Oil wastes, Industrial wastewater, Toxic wastes.

Phenolic compounds are hazardous pollutants because they are toxic to many organisms and are very often present in effluents from different industries, such as oil refineries, petrochemistry, and other organic products. Removal of phenols from wastewaters can be achieved by chemical oxidation, solvent extraction and adsorption on activated carbon, but biological methods are gaining importance, especially in the case of intermediate and low concentrations of phenols in effluents. A phenol-degrading strain, QT 31, of Pseudomonas was selected among other phenol-resistant bacteria from activated sludges of a wastewater treatment plant of an oil refinery. Its capacity for degradation was studied at different periods of adaptation, reaching a phenol biodegradation rate of 28 mg/L phenol/hr, from minimal medium with 100 mg/L phenol, after adaptation for 20 days. (Lantz-PTT)
W88-04507

ZEOLITE AS SUPPORT MATERIAL IN ANAEROBIC WASTEWATER TREATMENT,
National Centre for Scientific Research, Havana (Cuba).
E. Sanchez, and R. Roque-Malherbe.
Biotechnology Letters BILED3, Vol. 9, No. 9, p 671-672, September 1987. 1 fig, 2 tab, 4 ref.

Descriptors: *Zeolite, *Wastewater treatment, *Anaerobic digestion, Ion exchange, Adsorption, Biofilms.

Because of the properties of zeolites as ionic exchangers and adsorbers they neutralize biological media by proton exchange, and can trap cells increasing their viability. The property of proton exchange could be very useful in anaerobic wastewater treatment because of the low initial pH of the reactor feed and proton production by bacterial metabolism during anaerobic treatment. The effect of zeolite as packing material in an anaerobic filter used in the purification of bakers yeast wastewater was studied and compared with other support materials such as ceramic Raschig rings, PVC pellets, and CaCO3 stones. The conclusion that the combined effect of proton exchange and biofilm fixing significantly improved the efficiency of the zeolite-supported reactor in comparison with other support materials. (Lantz-PTT)
W88-04508

HEALTH FEARS CROP IRRIGATION PROMISE,
For primary bibliographic entry see Field 5C.
W88-04516

COMPOSTING SLUDGE WITH REEDS,
Tohoku Univ., Sendai (Japan). Biological Inst.
Y. Kurihara, T. Sato, T. Yoshida, and T. Mori.
BioCycle BCYCDK, Vol. 28, No. 8, p 38-41, September 1987. 2 fig, 5 tab, 4 ref.

Descriptors: *Sludge disposal, *Composting, *Reeds, *Wastewater treatment, Polymers, Sludge drying, Sludge thickening, Septic sludge, Biological oxygen demand, Aeration.

Composting of sewage sludge dewatered by way of polymers and mixed with the reed, Phragmites australis, was conducted under various conditions. The optimum mixing ratios of sludge (moisture content, approximately 80%) to Phragmites (moisture, from 33.7% to 59.6% inclusively) ranged from 20-50% on a wet weight basis. Initial aeration rates that were within the rates of 1.2 to 3.6 L/min/kg BOD, were found to be optimum. The composted Phragmites-sludge mixture exerted a beneficial effect on the growth of rice plants and the yield of grain. (Lantz-PTT)
W88-04524

EFFECTS OF SALINITY ON A RENDERING - MEAT PACKING - HIDE CURING WASTEWATER ACTIVATED SLUDGE PROCESS,
Purdue Univ., Lafayette, IN.
G. Witmayer, D. Froula, and G. Shell.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 20, No. 6, p 13-18, November-December 1987. 4 fig, 4 tab, 7 ref.

Descriptors: *Wastewater treatment, *Meat processing industry, *Activated sludge, *Salinity, Biomass, Sludge digestion, Sodium, Salts.

Increased salted hide production at a hide curing operation caused decreased treatment efficiency in an activated sludge process. Investigative sampling indicated that the biomass was extremely sensitive to sodium ion concentrations in excess of 1500 mg/L. Plant operations limited the amount of salt entering the plant and maintained a sodium ion concentration of 1000 to 1500 mg/L. Plant effluent quality after these modifications improved significantly. Because of discharge limitations on salinity quality and the negative effects of salinity on the activated sludge process, excess salt wastewater is evaporated. A bench scale treatability study indicated that an activated sludge biomass would fail to settle at sodium ion concentrations exceeding 30,000 mg/L as Na. The settleability observed at sodium ion concentrations below 7000 mg/L as Na compared favorably with a reference low salinity activated sludge unit. (Lantz-PTT)
W88-04527

UNICELLULAR PROTEIN PRODUCTION IN EFFLUENTS FROM PROCESSED MUSSELS. I: USE OF YEAST IN AXENIC AND MIXED CULTURES (PRODUCCION DE PROTEINA UNICELULAR EN EFLUENTES DEL PROCESADO DE MEJILLON. I: UTILIZACION DE LEVADURA EN CULTIVOS AXENICOS Y MIXTOS),
Instituto de Investigacones Pesqueras de Vigo (Spain).
M. A. Murado, M. P. Gonzalez, M. I. Montemayor, M. J. F. Reiriz, and J. M. Franco.
Investigacion Pesquera IJMDAI, Vol. 50, No. 4, p 571-605, December 1986. 15 fig, 6 tab, 50 ref.

Descriptors: *Food processing wastes, *Recycling, *Water reuse, *Wastewater treatment, *Mussels, *Yeasts, Glycogen, Chemical wastewater treatment, Chemical oxygen demand, Phosphorus, Nitrogen, Biodegradation, Microbiological studies.

The industrial processing of mussels in Galicia (Spain) generates large volumes of relatively glycogen-rich wastes that when freely poured into the sea, contaminate the coastal ecosystem. Treatment were studied here, with the double objective of reducing their contaminant impact and creating a way of using them that provides incentives for their depuration. The results obtained after the assays, of a process directed to SCP production, have permitted: (a) the obtaining of a small peptide fraction separable, without additional cost to the rest of the process during waste treatment prior to their use as a microbiological medium; (b) the reduction, by more than 80%, of the COD remaining after pretreatment, by means of different cultures, of several yeast species and a fungus, able to be used as SCP sources; (c) obtaining of an SCP production comparabie to or better than those achieved by other studies in the treatment of residual or low-cost substrates; (d) the facilitation, with respect to the processes applicable to the crude wastes, of the possible recovery of taurine from the postincubated medium; and, (e) the establishment of criteria for the possible P and/or N supplementation of some wastes, in order to attempt complete glycogen degradation by the selected species. (Author's abstract)
W88-04543

MONITORING AND CONTROL OF ANAEROBIC DIGESTION,
National Inst. for Water Research, Pretoria (South Africa).
W. R. Ross, and J. M. Louw.
Water SA, Vol. 13, No. 4, p 193-196, August 1986. 8 fig, 7 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Monitoring, Industrial wastes, Organic loading, Cations, Hydrogen ion concentration, Digestion, Chemical oxygen demand, Temperature, Sludge digestion, Sludge setting.

Digesters treating industrial wastes are frequently subjected to fluctuations in both waste composition and organic load, necessitating special precautions by of the operator to prevent metabolic overloading of the microorganisms. Various sensitive indices of digester stability are relevant to effective process control and operating reliability at high load rates. These are: (1) volatile acid: alkalinity: pH ratios for digester control; (2) relationship between cation availability and substrate buffer potential; (3) relationship between pH and volatile acids dissociation index; (4) measurement of microorganism activity; (5) relationship between gas production and mass of COD utilized; (6) relationship between temperature and loading rate; (7) relationship between sludge concentration and load rate; (8) indices for sludge settling characteristics; (9) relationship between load rate and sludge settling characteristics; and (10) sensory evaluation. The ease of operation of a digester and the degree of monitoring and control required are governed by such factors as: type of waste; plant design; load rates envisaged; operator experience; and monitoring and control facilities. Experience indicates that no single parameter is sufficiently sensitive to permit reliable forecasting of incipient overloading or digester failure, particularly at high load rates. (Lantz-PTT)
W88-04562

EFFECT OF PARTICLE SIZE AND INTERFERING IONS ON FLUORIDE REMOVAL BY ACTIVATED ALUMINA,
National Inst. for Water Research, Pretoria (South Africa).
J. J. Schoeman, and H. MacLeod.
Water SA, Vol. 13, No. 4, p 229-234, August 1986. 8 fig, 3 tab, 18 ref.

Descriptors: *Wastewater treatment, *Fluoride, *Particle size, Adsorption, Chemical wastewater treatment, Hydrogen ion concentration, Silicates, Phosphates, Alkalinity.

Fluoride removal by activated alumina was investigated to gain a better understanding of the effect of particle size and interfering ions. The fate of fluoride adsorption on smaller particles was significantly greater than on larger sized particles. The optimum pH for fluoride removal was about 6. However, it could be advantageous to remove fluoride at pH 4 to 5 where less competition from silicate was experienced. Silicate (as Si) and phosphate from 5 to 80 mg/l were found to have very little effect on fluoride removal efficiency. Sulfates in the concentration range from 100 to 1,600 mg/l had very little effect on fluoride removal efficiency. It appeared that the single most important factor affecting fluoride removal efficiency was the hydroxide and bicarbonate alkalinity of the water. (Author's abstract)
W88-04567

POTENTIAL AND ACTUAL BIOLOGICAL RELATED HEALTH RISKS OF WASTEWATER INDUSTRY EMPLOYMENT,
Cincinnati Univ., OH. Dept. of Environmental Health.
For primary bibliographic entry see Field 5C.
W88-04582

EVALUATION OF OXYGEN UPTAKE RATE AS AN ACTIVATED SLUDGE PROCESS CONTROL PARAMETER,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Architecture and Urban Studies.
S. Chandra, R. O. Mines, and J. H. Sherrard.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1009-1016, December 1987. 14 fig, 3 tab, 18 ref.

Descriptors: *Wastewater treatment, *Sludge digestion, *Oxygen uptake, *Respirometer, Biological oxygen demand, Activated sludge process, Organic loading, Process control, Respiration.

A laboratory study was conducted to determine whether or not oxygen uptake rate (OUR) is a valid control parameter for monitoring the activated sludge process. Two bench-scale reactors were operated at steady state and under shock load. No relationship could be deduced between effluent quality and OUR, suggesting that the latter would not be useful as a control parameter. As was concluded from the shock load data, OUR varies inconsistently at high organic loadings. It was found that the biological oxygen demand (BOD) bottle technique completely failed to measure oxygen uptake at high organic loadings and gave meaningless results. An on-line respirometer gave more realistic and consistent results. (Lantz-PTT)
W88-04583

ENGINEERING IMPLICATIONS OF A NEW TRICKLING FILTER MODEL,
Arizona Univ., Tucson. Dept. of Environmental Engineering.
B. E. Logan, S. W. Hermanowicz, and D. S. Parker.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1017-1028, December 1987. 13 fig, 7 tab, 31 ref.

Descriptors: *Trickling filters, *Wastewater treatment, *Model studies, *Wastewater facilities, Biological oxygen demand, Filtration, Engineering, Velz equation, Mathematical models, Hydraulic design.

A new trickling filter model incorporating media geometries were compared to the predictions of the modified Velz equation. The two approaches predicted similar effects of hydraulic loading on soluble biological oxygen demand (sBOD) removal. The model predicted slight improvements in sBOD removal with filter height, compared to large increases in sBOD removal using the modified Velz equation. The model also predicted a decrease in sBOD removal with increasing recycle, versus an increase in sBOD removal predicted by the modified Velz equation. The maximum aerobic sBOD removal capacity of a plastic media module was determined, although oxygen was not indicated to limit sBOD removal. A procedure was outlined for plastic media trickling filter design. (See also W88-04585) (Lantz-PTT)
W88-04584

FUNDAMENTAL MODEL FOR TRICKLING FILTER PROCESS DESIGN,
Arizona Univ., Tucson. Dept. of Environmental Engineering.
B. E. Logan, S. W. Hermanowicz, and D. S. Parker.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1029-1042, December 1987. 14 fig, 6 tab, 74 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Trickling filters, *Process design, *Computer models, Mathematical models, Model studies, Biochemical oxygen demand, Plastics.

A computer model was developed to examine soluble biochemical oxygen demand (BOD) removal in plastic media trickling filters. The performance of trickling filters was predicted using first order microbial kinetics and equations of substrate transport in the thin fluid film. Various geometrics of trickling filter support media caused different fluid hydraulics. The trickling filter model was calibrated and verified through comparison with several sets of laboratory, pilot plant, and full scale studies. (See also W88-04584) (Lantz-PTT)
W88-04585

DESIGN AND EVALUATION OF BIOFILTER TREATMENT SYSTEMS,
Black and Veatch, Kansas City, MO. Process Control Dept.
T. L. Johnson, and G. P. Van Durme.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1043-1049, December 1987. 8 fig, 5 tab, 11 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Biofiltration, *Activated sludge, Biological oxygen demand, Biological wastewater treatment, Respiration.

Full-scale operating data from several biofilter plants with wide geographical distribution were evaluated to prepare a model and an evaluation methodology for predicting soluble biological oxygen demand (BOD) removal and detailed biofilter effluent characteristics. This increased knowledge provides more accurate downstream facility designs. Traditional design equations cannot be relied on to accurately describe BOD removal by all biofilters. Graphical relationships for estimating soluble BOD removal vary approximately + or - 20%. Similar relationships for BOD removals (clarifier performance included) show an even greater variation. The full-scale plant data indicate oxygen-limited performance when biological sludge is recycled to the biofilter. Biofilter soluble BOD removal for sludge recycle systems can be estimated from oxygen transfer rate expressed as 0.0031 kg O2/d for each unit of media surface area and depth per unit of wetting rate above 0.5 l/sq m, where media surface area is the total bulk volume of media multiplied by its specific surface area. Insignificant amounts of suspended BOD are removed in the biofilter. No endogenous respiration takes place within the biofilter. Identifying soluble BOD removal and active mass formation within the biofilter is essential to accurate evaluation and biofilter system design. (Lantz-PTT)
W88-04586

ANAEROBIC FLUIDIZED BED AND ANAEROBIC FILTER/CONTACT STABILIZATION APPLICATION FOR HEAT TREATMENT LIQUOR,
EDI Engineering and Science, Grand Rapid, MI.
L. B. Pugh, S. J. Kang, and J. L. Spangler.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1050-1058, December 1987. 11 fig, 3 tab, 8 ref.

Descriptors: *Anaerobic digestion, *Fluidized beds, *Filtration, *Wastewater treatment, Chemical oxygen demand, Stabilization, Organic loading, Biofiltration, Pilot plants, Heat treatment.

Two anaerobic processes for pretreatment of the heat treatment liquor were pilot tested: the anaerobic fluidized bed process and the AF/CS (anaerobic filter/contact stabilization) process. The performance of the pilot systems was evaluated at several loading rates ranging between 2600 and 45,000 gm soluble chemical oxygen demand (COD)/cu m/day. The anaerobic fluidized bed system, loaded at a much higher rate than the AF/CS system, exhibited consistently high COD removal efficiency at high organic loadings. Average removal efficiencies for soluble COD ranged between 60 and 70% for both systems. Gas production averaged 0.4 l/gm of COD removed, with a methane content between 76 and 79%. Based on the superior performance of the fluidized bed system, a full-scale system was designed with construction scheduled for completion in late 1987. (Lantz-PTT)
W88-04587

SURFACE COMPLEX MODEL FOR ADSORPTION OF TRACE COMPONENTS FROM WASTEWATER,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
B. Batchelor, and R. Dennis.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1059-1068, December 1987. 9 fig, 4 tab, 43 ref. OWRT Grant No. 14-34-0001-0499.

Descriptors: *Wastewater treatment, *Model studies, *Adsorption, *Trace elements, Organic carbon, Hydrogen ion concentration, Chromates, Phosphates, Lead, Activated sludge process.

A surface complex adsorption model is used to describe the results of batch equilibrium experiments investigating adsorption of hydrogen ion, chromate, phosphate, lead, and total organic carbon (TOC) onto activated alumina. These tests were conducted using domestic wastewater treatment by the activated sludge process, and lime coagulation. Surface complex models describe adsorption as formation of surface complexes between a component of the solid and the adsorbate in a manner analogous to formation of complexes in solution. The surface complex model applied to this work was able to adequately describe adsorption of the hydrogen, chromate, and phosphate ions onto alumina. However, the model did not adequately describe adsorption of lead and total organic carbon. (Lantz-PTT)
W88-04588

INTEGRATED PROCESS FOR BIOLOGICAL TREATMENT OF SULFATE-CONTAINING INDUSTRIAL EFFLUENTS,
National Inst. for Water Research, Pretoria (South Africa).
J. P. Maree, A. Gerber, and E. Hill.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1069-1074, December 1987. 5 fig, 2 tab, 18 ref.

Descriptors: *Biological wastewater treatment, *Sulfates, *Industrial wastewater, Gold mine wastes, Anaerobic digestion, Sulfur, Chemical oxygen demand, Cyanide, Hydrogen sulfide, Calcium carbonate, Wastewater treatment.

During this investigation, upflow anaerobic, packed bed or upflow anaerobic, suspended sludge reactors were used to treat gold mine effluents.

The biological process following the addition of an organic carbon source such as molasses, converts sulfate to gaseous hydrogen sulfide. During primary anaerobic treatment, influent sulfate at 2,480 mg/l was reduced to 180 mg/l (as SO4). In addition 220 mg/l sulfide (as SO4), elemental sulfur, and metal sulfides were produced. Heavy metals were efficiently removed in this stage while calcium carbonate reached oversaturation levels. The end-products occurring in anaerobically treated water, namely soluble organic carbon, residual hydrogen sulfide, and calcium carbonate, were successfully removed in a subsequent aerobic stage. In this stage, COD was removed to 300 mg/L, hydrogen sulfide to 20 mg/l, while 1070 mg/l calcium carbonate crystallized out. Complex cyanides were removed from 6.5 to less than 1.0 mg/l (as CN). A C:N:P ratio of 50:5:1 was effective for proper aerobic bacteria functioning. The secondary anaerobic stage serves a polishing function. Weakly biodegradable organic components originating from the molasses (used at 3 ml/l to dose feedstock), as well as heavy metals, are removed to below detectable levels. This integrated biological process is a viable option for sulfate removal and should be further developed for large scale application. (Lantz-PTT)
W88-04589

STOCHASTIC WATER QUALITY OPTIMIZATION USING IMBEDDED CHANCE CONSTRAINTS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W88-04603

SEWAGE TREATMENT IN HELOPHYTE BEDS - FIRST EXPERIENCES WITH A NEW TREATMENT PROCEDURE,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
K. Bucksteeg.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 1-10, 1987. 7 fig, 12 ref.

Descriptors: *Wastewater treatment, *Helophytes, *Biological wastewater treatment, Aquatic plants, Root zone, Soil properties, Biological oxygen demand, Chemical oxygen demand, Nitrogen, Phosphorus, West Germany, Costs, Wastewater treatment facilities.

Wastewater treatment in helophyte beds under humid climate conditions has been favored by some German ecologists for some years. The idea is to cause wastewater to flow horizontally through the root zone of helophytes to achieve satisfactory effluent properties. There exist many highly different proposals regarding the choice of soil and helophytes to be applied, bed area, design of inlets and outlets and operation conditions. A few plants have been operated in practice for some years. It appears that clogging is one of the main problems occurring in these plants. Comparisons with observations of plants in operation are drawn. The interactions between soil properties, its uptake capacity, BOD-, COD-, N-, P-reduction are evaluated. The effluent results of helophyte beds are compared with those of low-loaded trickling filters and of ponds used for sewage treatment in small villages in rural areas of Germany. It has been proved that the total construction costs of sewage treatment plants with helophyte beds used as the biological stage are higher when compared with those of conventional plants in general. (Author's abstract)
W88-04613

USE OF WATER HYACINTH IN TERTIARY TREATMENT OF DOMESTIC SEWAGE,
Fortes (Joao) Engenharia, Rio de Janeiro (Brazil).
M. C. Araujo.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 11-17, 1987. 3 fig, 5 tab, 9 ref.

Descriptors: *Tertiary wastewater treatment, *Water hyacinth, *Biological wastewater treatment, *Phosphorus, Wastewater treatment, Orthophosphates, Aquatic plants, Domestic wastes.

The reduction of phosphorus with the use of water hyacinths in tertiary treatment of domestic sewage is verified and quantified. Secondary effluents from a small treatment station were run through a series of four tanks containing water hyacinths. Measurements and analyses were conducted to verify reduction of nutrients in the final effluent. Results showed removals of up to 88% orthophosphates (leaving 0.21 mg/l) for an average detention time of 5.44 days. The average flow was 3.3 cu m/day. These encouraging results suggest the practical value of the method when there is the need of tertiary treatment for the sewage of small communities. (Author's abstract)
W88-04614

APPLICABILITY OF THE WASTEWATER TREATMENT PLANT IN OTHFRESEN AS SCIENTIFIC DOCUMENTATION OF THE ROOT-ZONE METHOD,
Aarhus Univ. (Denmark). Botanical Inst.
H. Brix.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 19-24, 1987. 1 fig, 1 tab, 9 ref. Danish Natural Science Research Council Project No. 11-4591.

Descriptors: *Wastewater treatment, *Data interpretation, *Othfresen, *West Germany, Biological wastewater treatment, Aquatic plants, Wetlands, Nitrogen, Root zone, Nitrogen.

Documentation for the functioning of the root-zone method of wastewater treatment is based almost exclusively on data from the Othfresen plant in West Germany, a 22.5 ha wetland, which since 1974 has received municipal wastewater. The present paper describes the working experiences from Othfresen, and evaluates the applicability of the data from Othfresen as basis for the scientific documentation of the root-zone method in general. It is concluded that the data from Othfresen are useless in the documentation of the root-zone method for the following reasons: (a) The loaded area has not been well-defined until 1985, (b) the soil in the treatment plant is very atypical (old mine debris), (c) a major proportion of the wastewater does not penetrate the soil, but distributes on the surface as overland flow, (d) the quality of the water in the 'defined' outlet, i.e., a well consisting of a PVC-tube, has no relation to the treatment of wastewater in the area, and (e) the true effluent to the the receiving stream (Innerste) is of varying quality, especially as far as nitrogen is concerned. It is therefore necessary to await results from well-controlled experimental treatment plants before the functioning and the applicability of the root-zone method can be properly evaluated. (Author's abstract)
W88-04615

HIGH ORGANIC LOAD STABILIZATION POND USING WATER HYACINTH - A 'BAHIA' EXPERIENCE,
Universidade Federal d
E. J. Santos, E. H. B. Silva, J. M. Fiuza, T. R. O. Batista, and P. P. Leal.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 25-28, 1987.

Descriptors: *Organic load, *Stabilization ponds, *Water hyacinth, *Biological wastewater treatment, Biological oxygen demand, Suspended solids, Biomass, Productivity, *Wastewater treatment, Domestic wastes, Mosquitoes, Insect control.

A wastewater treatment pond covered with water hyacinth (Eichhornia crassipes) was first tested in Bahia in an attempt to treat sewage from an urban area in Salvador, Bahia, Brazil. This pond, which receives a high organic load with an average of 750 kg BOD/ha/day, after a short detention time of as little as 5 days, exhibited a removal rate efficiency of 90.7% of BOD and 96% of suspended solids. The problems related to the operation of this plant and its limitations, mainly regarding removal of nutrients, are discussed. Conclusions of the study include: (1) High organic load hyacinth stabilization ponds with a plug-flow hydraulic approach effectively remove organic and suspended solids from the final effluent; (2) Ponds, such as the one studied in this research, are poor systems for the removal of nutrients; (3) The plants created a favorable habitat for mosquitoes in the pond and they appeared in large numbers; (4) The disposal of hyacinths, due to the low productivity of biomass, did not become a problem in the management of the wastewater treatment plant; and (5) Ponds similar to the one studied in the present research work are a suitable option for the treatment of domestic wastewater, especially in view of their low costs. Recommendations from the study include: (1) An evaluation of the hydraulic flow to quantify the real retention time and type of flow will clarify some aspects relative to pond behavior, and will help in the improvement of future designs; (2) From an ecological view, biological control of mosquitoes in hyacinth ponds should be stimulated, instead of chemical control, to keep this control as much as possible independent of human interference; and (3) Biological studies of the water hyacinth in a high load stabilization pond should be intensified in order to have a better knowledge of the role of this peculiar plant in such a habitat. (Lantz-PTT)
W88-04616

DOMESTIC WASTEWATER TREATMENT IN TANKS PLANTED WITH ROOTED MACROPHYTES: CASE STUDY; DESCRIPTION OF THE SYSTEM; DESIGN CRITERIA; AND EFFICIENCY,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France).
C. Boutin.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 29-40, 1987. 5 fig, 7 tab, 5 ref.

Descriptors: *Domestic wastes, *Wastewater treatment, *Macrophytes, *Wastewater treatment facilities, Load distribution, Biological wastewater treatment, Case studies, Design standards, Chemical oxygen demand, Biological oxygen demand, Nitrogen, Aquatic plants.

Macrophyte beds have been studied as a new procedure in water treatment. The system is made up of a series of watertight tubes filled with gravel and rooted with aquatic plants. Since autumn of 1982, this plant has been treating the wastewater of a rehabilitation center which functions according to a scholastic calendar. Receiving loading of 28 population equivalents, the plant must be able to cope with loading variations reaching a factor of 6. The total planted surface is 63 sq m (2.5 sq m/population) equivalent. The different series of measurements taken during an annual plant cycle show that: the abatement of the organic loading (COD, BOD) reaches 85% to 90%; the elimination rate of total nitrogen is near 50%; and, the phosphorus is mineralized but is not retained by the treatment. Sampling of effluent discharge, taken several times over a three year study period, showed that the effluent quality had degraded. Decreasing quality of the discharge was predictable because the station had been functioning at an average 135% of its nominal for 3 wk. During weekdays, the station's peak level was 190% of its nominal load. A new plant of the same layout, but with planted surface adapted to 500 population equivalent was planted in 1985. (Lantz-PTT)
W88-04617

HORNSBY BEND HYACINTH FACILITY IN AUSTIN, TEXAS,
R. Dinges, and J. Doersam.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 41-49, 1987. 6 fig, 1 tab, 5 ref.

Descriptors: *Wastewater treatment facilities, *Water hyacinth, *Austin, *Texas, Wastewater treatment, Aquatic plants, Biological wastewater treatment, Sludge digestion, Aerobic digestion, Greehouses, Ecosystems.

The Hornsby Bend Hyacinth Facility, the first such system built under the U.S. EPA 'Construction Grants Program', represents the culmination of over a decade of experience at the City of

Austin with hyacinth treatment. The facility consists of three culture basins 265 m in length with an area of 1.6 ha. To permit year-round hyacinth culture, basins are covered with a 2.06 ha unitary greenhouse structure. Fenced exclusion areas at intervals along sides of basins serve as natural aerators and enhance fish production. The system, operated in an aerobic mode, was designed to treat daily about three million liters of sludge lagoon supernatant. Exclusion of large vertebrate predators and stocking of basins with selected animal species will provide a unique ecosystem. Basins were planted with hyacinths in late October, 1985 and discharge commenced on February 3, 1986. Functional characteristics and ecological considerations of the facility are discussed and operational performance data are presented. Maintenance harvesting of hyacinth and disposition of plant material are described. Application of greenhouse hyacinth treatment systems are addressed. (Author's abstract)
W88-04618

EXPERIMENTAL INVESTIGATIONS INTO THE USE OF EMERGENT PLANTS TO TREAT SEWAGE IN SOUTH AFRICA,
Scott and deWaal, Inc., Sandton (South Africa).
W. V. Alexander, and A. Wood.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 51-59, 1987. 5 fig, 2 tab, 13 ref.

Descriptors: *Wastewater treatment, *South Africa, *Experimental designs, *Aquatic plants, Water quality control, Biological wastewater treatment, Tertiary wastewater treatment, Nitrogen, Phosphorus, Escherichia coli, Domestic wastes.

South Africa is a relatively water-short country which has many rural communities with waterborne sewage infrastructures requiring low technology treatment facilities. In order to protect the water resources of the country the authorities have set high standards for effluent quality (COD < 75 mg/l, NH3 < 10 mg/l, E. coli < 1000 and in some areas P < 1 g/l). Traditionally, oxidation ponds have been used in these applications but have not been able to consistently meet the required standards. Recently interest has been shown in artificial wetlands as a low technology means of solving the problem. Several experimental projects are at present being initiated in South Africa, both as primary and secondary treatment for domestic sewage and also as a tertiary treatment to remove nitrogen, phosphorus and E. coli from conventional sewage plant effluents. The designs of these experimental projects are described here, with the emphasis being: (1) to treat raw domestic sewage from small rural communities to meet the general standard; (2) to upgrade the quality of effluent from oxidation ponds to ensure it meets the general standard; and (3) to provide a tertiary treatment to remove phosphorus from secondary effluents in order to meet the special phosphorus standard in sensitive catchments. (Lantz-PTT)
W88-04619

STATE-OF-THE-ART UTILIZATION OF AQUATIC PLANTS IN WATER POLLUTION CONTROL,
Central Florida Research and Education Center, Sanford, FL.
K. R. Reddy, and T. A. DeBusk.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 61-79, 1987. 2 fig, 9 tab, 59 ref.

Descriptors: *Wastewater treatment, *Aquatic plants, *Water pollution control, Water quality control, Artificial wetlands, Hydraulic retention time, Biological oxygen demand, Suspended solids, Heavy metals, Secondary wastewater treatment, Biological wastewater treatment, Economics.

Research, pilot-scale and operational studies conducted within the past 15 years have shown that aquatic macrophyte-based treatment system offer a promising, low-cost method for removing contaminants from wastewaters and polluted natural waters. The vascular plants cultured in such treatment systems perform several functions, including assimilating and storing contaminants, transporting O2 to the root zone, and providing a substrate for microbial activity. For wastewater treatment, two types of systems are typically utilized: (1) floating aquatic macrophytes cultured in ponds or channels, and (2) emergent macrophytes cultured in artificial wetlands using gravel or soil substrate. For floating macrophyte systems using water hyacinths and the system receiving primary sewage effluent, a 6-day hydraulic retention time (HRT), water depth of 60 cm, and a hydraulic loading of 1860 cu m ha/day are adequate for meeting secondary treatment standards. In such a system, BOD and suspended solids have been reduced by 80-90%. Similarly, systems receiving conventional secondary sewage effluent, HRT of 6 days, and hydraulic loading of 800 cu m ha/day were found to be adequate for achieving advanced secondary treatment. Similar results have also been observed for artificial wetlands using emergent macrophytes. Aquatic plants remove pollutants by: (1) directly assimilating them into their tissue; and (2) providing a suitable environment for microorganisms to transform pollutants and reduce their concentrations. Plant harvest is needed to enhance P removal, and it may also influence oxygen transfer into the root zone, thus enhancing N and BOD removal. Removal of heavy metals from wastewaters can also be accomplished when plants are harvested. Biomass produced can be utilized as a source of feedstock for producing methane, cattle feed, or composted and used as organic manures. Economics of utilization will depend on the costs of conventional materials used for the same purpose. Operating costs for crop management and harvesting may be offset by biomass product resources. (Lantz-PTT)
W88-04620

FIGHT AGAINST EUTROPHICATION IN THE INLET OF 'ODENSE FJORD' BY REAPING OF SEA LETTUCE (ULVA LACTUCA),
Municipality of Odense (Denmark). Odense Magistrat.
For primary bibliographic entry see Field 5G.
W88-04621

UTILIZATION OF WATER HYACINTH FOR REMOVAL AND RECOVERY OF SILVER FROM INDUSTRIAL WASTEWATER,
Instituto Nacional de Tecnologia, Rio de Janeiro (Brazil).
C. L. R. Pinto, A. Caconia, and M. M. Souza.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 89-101, 1987. 4 fig, 6 tab, 33 ref.

Descriptors: *Water hyacinth, *Water pollution control, *Silver, *Industrial wastewater, *Biological wastewater treatment, *Wastewater treatment, Heavy metals, Aquatic plants, Water quality control, Absorption, Chemical analysis.

The water hyacinth (Eichhornia crassipes) was studied as a pollution monitor for accumulation of silver and subsequent recovery of the element from the plant tissues. After cultivation of the plants for 24 hours in silver solution containing 40 mg/l the plants were harvested, rinsed with tap water and dried at 110 C for 48 hours. The dried material was submitted to pyrolysis and chemical digestion and the silver absorbed by the plant was precipitated, calcinated and recovered in the metal form. The average concentration of silver was found to be 8,000 mg/gm of dried plant material. An atomic absorption spectrophotometer was utilized for the analysis. The average concentration of silver recovered from the dried plant material was 70% of the initial silver concentration of the solutions and revealed a purity of 98%. The water hyacinth has the potential of producing 873/ha/day of dried material and can be used for the production of biogas rich in methane. After the wastewater treatment, the harvested plants can be used for biogas production and the residual sludge may be utilized for recycling the valuable metal. (Author's abstract)
W88-04622

TREATMENT OF TEXTILE INDUSTRY WASTE USING WATER HYACINTH,
Y.C. Coll. of Science, Karad (India). Dept. of Environmental Pollution.
P. K. Trivedy, and V. R. Gudekar.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 103-107, 1987. 5 tab, 9 ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water hyacinth, *Textile mill wastes, Biological wastewater treatment, Chemical oxygen demand, Biological oxygen demand, Suspended solids, Dissolved solids, Nitrogen, Sodium, Phosphorus, Nutrients, Magnesium, Potassium.

The efficiency of water hyacinth in the treatment of textile industry waste is reported. The effect of prior settling of the waste on the efficiency of the treatment was also studied. The hyacinth was grown in 100%, 50% and 25% concentrations of both original and settled wastewater for four days in laboratory tanks. The water hyacinth was highly capable of removing pollutants from the original waste as compared to the settled waste, though the treatment was adequate even with the settled waste. The best treatment was obtained with 100% waste. There was 65.31% reduction in conductivity in 100% settled waste and 53.86% reduction in 100% original waste. COD reduction in original waste was maximum with 25% concentration (97.35%) on the third day. With settled waste there was 92.97% reduction in COD on the third day. With settled waste the period of 4 days was needed to get a maximum reduction in conductivity, COD, BOD and TSS. For original waste, maximum reduction in conductivity, COD, BOD and TSS was noted on the third day. Total solids were reduced by 62.42% in 100% waste on the third day. Fifty percent and 25% concentrations showed 41.35% and 47.21% reduction on the fourth day. Suspended solids were left in traces in 50% and 25% concentration on the fourth day. Among nutrients analyzed on the fourth day, the overall reduction in potassium was maximum, i.e. 90.45% to 99.39%. Nitrogen, sodium and phosphorus were also reduced to a good extent. The initial and final harvested plant material was analyzed for various nutrients like Ca, Mg, Na, K, N and P. There was accumulation of sodium, potassium and nitrogen in the shoot from both original and settled waste, whereas the reduction in magnesium and nitrogen content was noted in the roots. (Author's abstract)
W88-04623

PURIFICATION OF PISCICULTURE WATERS THROUGH CULTIVATION AND HARVESTING OF AQUATIC BIOMASS,
CEA Centre de Pierrelatte (France).
C. Simeon, and M. Silhol.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 113-121, 1987. 7 fig, 3 tab, 7 ref.

Descriptors: *Wastewater treatment, *Aquatic plants, *Pisciculture, *Biomass, *Fish farming, Biological wastewater treatment, Thermal wastes, Water hyacinth, Macrophytes, France, Pilot plants.

The study of thermal wastes from the nuclear plants around Pierrelatte (France) for agricultural, piscicultural, energy and environmental protection purposes resulted in the establishment of a pilot facility as early as 1976. An aquatic macrophyte pilot facility has been operational since 1983 to study the use of water hyacinths from the aspects of energy and ecology. The results obtained suggest that production yields for the 7 month growing period should exceed 60 metric tons (MT) (dry weight) per hectare in a European climate, and that such crops can feasibly be cultivated in temperate regions. The pilot facility is supplied with pisciculture effluent water, making it possible to quantify the stabilization power of the plants. Without primary decantation, with a retention time of 4 days and stabilization with water hyacinths only, the organic matter waste pond surface area required is 3.5 sq m/sq m of pisciculture pond. Any primary or secondary facilities will lead to a reduction of these areas. The final decision will depend on the economical optimization of all the wastewater. (Author's abstract)
W88-04625

INCORPORATION OF CADMIUM BY WATER HYACINTH,
Universite de Savoie, Chambery (France). Lab. de Biologie.
G. Blake, B. Kaigate, A. Fourcy, and C. Boutin.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 123-128, 1987. 4 fig, 1 tab, 11 ref.

Descriptors: *Biological wastewater treatment, *Cadmium, *Water hyacinth, Bioaccumulation, Tissue analysis, Aquatic plants, Heavy metals, Toxicity, Wastewater treatment.

Water hyacinth (Eichhornia crassipes) has demonstrated its ability to remove nutrients and other chemical elements from sewage effluent in the process of producing larger quantities of biomass. This study attempts to compare the incorporation of cadmium in batch experiments or continuous systems. Different concentrations of cadmium (0.25, 0.50, 1.00, 2.00 ppm) were used, with toxic effects obvious at 1.00 ppm concentration. The distribution of the metal was followed in the medium and in different parts of the plant. As expected, the roots accumulated the major part (73-86%) of the incorporated cadmium. The change of biomass of different experiments is presented in regard to cadmium concentration. (Author's abstract)
W88-04626

PILOT-SCALE EXPERIMENTS IN WATER HYACINTH LAGOONS FOR WASTEWATER TREATMENT,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
H. Kawai, M. Y. Uehara, J. A. Gomes, M. C. Jahnel, and R. Rossetto.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 129-173, 1987. 9 fig, 31 tab, 22 ref.

Descriptors: *Pilot plants, *Water hyacinth, *Wastewater treatment, Tertiary wastewater treatment, Compost, Mosquitoes, Aquatic plants, Industrial wastewater, Biological wastewater treatment, Brazil, Insect control.

Since 1980, a series of pilot scale experiments in order to evaluate the real applicability of water hyacinth to wastewater treatment in Brazil. Conclusions from the experiments carried out to date indicate that the water hyacinth lagoon has a better performance when it is integrated with other treatment systems, especially at a tertiary level, instead of its direct application to raw sewage treatment. One of the operational problems of this system, is the intense proliferation of mosquitos, the control levels of which were not satisfactory even with the periodical application of a larvicide. The problem of water hyacinth removal and its use as biomass has not been solved at the industrial level yet. Use of the water hyacinth as an organic compost has proved to be economically infeasible, on an industrial scale, considering that there are many other residues which offer better alternatives both from the economic point of view and the available amounts. (Author's abstract)
W88-04627

RESTORATION OF THE ABILITY TO SETTLE BULKING SLUDGE BY BACTERIAL SEEDING IN WASTEWATER TREATMENT,
Okayama Univ. of Science (Japan). Biotechnology Lab.
I. Nozawa, N. Takizawa, and H. Kiyohara.
Journal of Fermentation Technology JFTED8, Vol. 65, No. 3, p 333-340, June 1987. 8 fig, 1 tab, 14 ref.

Descriptors: *Wastewater treatment, *Bulking sludge, *Activated sludge process, *Biological wastewater treatment, Food-processing wastes, Bacteria, Protozoa, Night soil, Chemical oxygen demand, Sludge volume index, Municipal wastewater.

An attempt ot restore the settling ability of denatured bulking sludge was undertaken by changing the microflora in waste treatment tanks. A cell suspension of mixed cultures of ten strains of bacteria, which were isolated from normal activated sludge from night soil plants, and a type culture Zoogloea ramigera IAM 1236 was seeded into a laboratory-scale aeration tank containing bulking sludge collected from municipal night soil or a food processing (bean curd production) waste treatment plant. The tank was fed with synthetic wastewater or industrial waste and aerated for 22 days. After 5 days, the microflora in the sludge changed remarkably with the seeding of the bacterial culture; filamentous organiams disappeared and active protozoa (Vorticella sp., Epistylis sp., and Lecane sp.) appeared. The sludge became compact and settled rapidly. The sludge volume after 30 min settling of the sludge temporarily increased, but in the end decreased from 97 to 20%. The CODcr value decreased from 300 to 20 ppm. In the tank without seeding, the sludge contained almost entirely filamentous organisms, which floated and finally decomposed. The effects were confirmed by applied tests in 700-ton scale and 100-ton scale aeration tanks of municipal night soil and a food processing waste treatment plant, respectively. (Author's abstract)
W88-04656

EFFECTS OF CATIONIC SURFACTANTS ON SETTLING PROPERTIES OF SEWAGE ACTIVATED SLUDGE,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
K. Kakii, M. Tamura, K. Umihoko, T. Shirakashi, and M. Kuriyama.
Journal of Fermentation Technology JFTED8, Vol. 65, No. 5, p 583-588, October 1987. 7 fig, 2 tab, 13 ref.

Descriptors: *Activated sludge process, *Advanced wastewater treatment, *Wastewater treatment, *Surfactants, *Sludge conditioning, *Cation exchange, Ionization, Wastewater oxidation, Molecular structure, Settleable solids, Sludge volume index.

Various alkyltrimethylammonium bromides (ATABs, R=C1 to C16) were added to a mixed liquor of sewage activated sludge and the effects on settling properties were investigated. The 30-min. settled sludge volume decreased from 28% to 24, 20, 17, and 15% on addition of 1 mM C10, C12, C14 and C16 compounds to mixed liquor (sludge concentration, 1.28 g/l), respectively. With increasingly alkyl chain length, the amounts of ATABs adsorbed by the sludge, and metal ions released from the sludge, increased. However, a quantitative correlation was not observed between the two. The adsorption of ATABs resulted in a small decrease in sludge wet weight, but such a change was not observed on addition of ATABs bearing short alkyl chains. A good correlation was observed between the amounts of ATABs adsorbed and their organic solvent/water partition coefficients. These results indicated that the effectiveness of ATABs as sludge conditioners depends on their hydrophobicity. (Author's abstract)
W88-04657

OPINION DIFFERENCES IN DESIGN LEAD TO PROOF OF PROCESS,
Black and Veatch, Kansas City, MO.
J. E. Touselee, B. O. Lendermon, and J. R. Collins.
Water Engineering and Management WENMD2, Vol. 134, No. 9, p 30-32, September 1987.

Descriptors: *Wastewater treatment, *Filtered wastewater, *Activated sludge, *Biofiltration, *Aeration, *Wastewater facilities, *Memphis, Tennessee, Biological oxygen demand, Suspended solids.

The activated sludge process coupled to activated biofilters was established as a viable treatment system in Memphis. The Thomas E. Maxson wastewater treatment plant, completed in 1975, was not able to meet the EPA's 30/30 (BOD/TSS) standards in 1977. In 1978 a three-pronged effort was made to bring the treatment plant into compliance through improved plant operation, control of industrial loadings, and design and construction of plant improvements. Short-range modifications were made to the aeration system, and long-range alternatives were considered. The addition of activated biofiltration to the existing facilities was selected. Black & Veatch engineers called for eight 135-ft diameter biotowers to handle organic loading of 150 lbs. BOD per day for 1,000 cu ft of volume; EPA engineers believed four towers constructed to handle a loading of 300 lbs BOD per day for 1,000 cu ft of volume would be effective. Four towers were constructed and extensive testing carried out. Existing aeration basins could not handle the loading remaining after biofiltration. The capacity of the system could be increased by installing more recirculation pumps, adding oxygen transfer capacity to the biotowers, building more biotowers, or increasing aeration capacity following the biotowers. (Thomas-PTT)
W88-04661

OPTIONS IN BELT FILTER PRESSES,
McIlvaine Co., Northbrook, IL.
N. D. Deutsch.
Water Engineering and Management WENMD2, Vol. 134, No. 9, p 34-37, September 1987. 4 fig.

Descriptors: *Wastewater treatment, *Sludge conditioning, *Dewatering, *Sludge drying, *Belt filter press, *Gravity belt filter, Wastewater facilities, Organic matter.

The five operating zones of a basic belt filter press (feed and conditioning, gravity drainage, squeeze between two belts in the wedge zone, the pressure zone, and cake discharge) are examined and contradictions in design illustrated. Chemical conditioning of the slurry is affected by the misapplication of shear forces. The length, inclination, and belt support of the gravity drainage section are reviewed, and recently designed gravity belt filters are described. Longer wedge zones are preferred to shorter. The number, diameter, and configuration of pressure rolls are reviewed; more rather than fewer rolls, rolls in a sequence of diminishing diameters, and more complete wrap of belt over roll are preferred. Belt tensioning controls (pneumatic, hydraulic), seamless belts, and belt cleaning techniques are discussed. Cake discharge, transport, and disposal and the pitfalls of performance evaluations of belt filter presses are considered. Side-by-side testing of organic material is recommended because of day-to-day variation of slurry composition. (Thomas-PTT)
W88-04662

CONTROLLED FLOW MANAGEMENT HELPS AVERT OVERFLOWS, SAVES MONEY,
CH2M Hill, Milwaukee, WI.
H. F. Padgham.
Water Engineering and Management WENMD2, Vol. 134, No. 9, p 38-40, September 1987.

Descriptors: *Flow Control, *Wastewater treatment, *Flow regulators, *Computers, *Tunnels, *Wastewater management, *Storm wastewater, Milwaukee, Lake Michigan, Milwaukee river, Kinnickinnic river, Wastewater facilities, Menomonee river, Wisconsin wastewater facilities.

The Milwaukee Metropolitan Sewerage District undertook a water pollution abatement program in the late 1970s in response to an average of 50 annual overflows of sewage into the Milwaukee, Kinnickinnic, and Menomonee rivers and Lake Michigan. Working with a consortium of design and construction management consultants under the leadership of CH2M Hill, it adopted a computer-controlled flow management system, which was designed by CH2M Hill and implemented and installed by Johnson Controls, Inc. Recommendations were made to tighten up infiltrated sewers where cost-effective and to build 17 miles of 17- to 32-ft-diameter deep storage tunnels. The JC-5000 system, a distributed digital process controls system, diverts flows within the collection system and between two wastewater treatment plants, and into a deep tunnel system during heavy wet weather. The tunnels will help cut the 50 annual overflows to two. The master station computer, housed on Milwaukee's south side, is connected ty telephone lines to 80 remote telemetry units, each of which may be connected to 30 or 40 other control

points. The successful completion of the system was based on a rigorous set of basic specifications, defining the district's requirements; a system functional specification, an agreement between district and consultant engineers on the characteristics of the end product; and installation and testing supervised by control and systems engineers. (Thomas-PTT)
W88-04663

TEST PROGRAM IMPROVES SEWER REHABILITATION,
RJN Environmental Associates, Inc., Wheaton, IL.
S. R. Maney, and R. J. Nogaj.
Water Engineering and Management WENMD2, Vol. 134, No. 9, p 42-44, September 1987. 3 tab.

Descriptors: *Sewer systems, *Manhole cover testing, *Leakage, *Dye releases, *Air testing, *Weir test, *Television, *Sewer rehabilitation, Contracts, Testing procedures.

Rehabilitation of wastewater collection systems is more effective if a testing program is implemented. RJN Environmental Associates, Inc. has a rehabilitation effectiveness testing program that can be used to quantify flow from a sewer system defect after rehabilitation. Testing techniques (manhole surface flooding, manhole dye injection, television inspection with dye water flooding, air testing, and weir testing) are described for specific defects (manhole cover holes, manhole frame defects, manhole structure defects below the frame, defective sewer line sections, leaking joints, leaking service connections, leaking lateral, and direct stormwater connection defects). The value of the testing program is demonstrated by its application to sewer system rehabilitation in four communities, Des Plaines, Elk Grove Village, Winnetka, and Hoffman Estates, in metropolitan Chicago, with over 7000 manholes serving 36,000 ft of force main and almost 2,000,000 ft of gravity sewer. A total of 2,322 manholes were tested, at an average of 10 minutes per manhole. As much as 13.7% of manholes leaked after rehabilitation before the testing program was operational. After implementation of testing, reduction of inflow from repaired main line defects was found to be 100 percent. The effectiveness of the testing program suggests that it should be incorporated into construction documents and paid for as a contract line item. Such testing can also be used prior to rehabilitation for accurate assessment of defects before specific rehabilitation methods are recommended. (Thomas-PTT)
W88-04664

SEPTIC TANK DRAINAGE CONDUIT STRUCTURES,
W. D. Johnson.
U.S. Patent No. 4,313,692; February 2, 1986, 6 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1015, No 1, p 168, February 2, 1982.

Descriptors: *Patents, *Conduits, *Septic tanks, *Wastewater treatment, *Drainage systems, Clays, Septic wastes, Water transport, Subsoil drainage.

A drainage conduit is placed in a trench connected to a septic tank for the conveyance of wastewater for absorption into the soil surrounding the conduit. The conduit consists of a main body assembly with a top wall mounted on spaced support legs. The legs contain drainage holes for wastewater flow. The main body assembly contains an open area between the support legs and downward from the lower surface of the top wall to permit the free flow of the wastewater into the soil, which is generally composed of solid clay. (Cremmins-AEPCO)
W88-04729

PURIFICATION OF SECONDARY RECOVERY WATERFLOOD LIQUIDS,
Atlantic Richfield Co., Los Angeles, CA.
G. D. Hansen.
U.S. Patent No. 4,502,959; March 5, 1985, 3 p, 1 tab. Official Gazette of the United States Patent Office, Vol 1052, No 1, p 287, March 5, 1985.

Descriptors: *Patents, *Secondary oil recovery, *Water reuse, *Oil wells, Water bleeding, Polymers, Separation techniques, Gums.

Polysaccharide gums are removed from aqueous waterflood liquids used in secondary oil recovery operations. The gum-containing aqueous liquid is contacted with a water-soluble copolymer of styrene and maleic anhydride having a molecular weight in the range of about 500 to 5000 and a styrene to maleic anhydride molar ratio in the range of 1:1 to about 10:1 in an amount sufficient to form an agglomerate of the polysacchardei gum and the copolymer. The agglomerate is removed from the aqueous liquid. (Cremmins-AEPCO)
W88-04730

METHOD OF TREATMENT FOR SEPARATION OF OIL FROM OIL-CONTAINING SLURRY WASTE,
Sankyo Yuki K.K., Hiratuka (Japan).
T. Yoshida.
U.S. Patent No. 4,555,345; November 26, 1985, 18 p, 9 fig, 5 tab. Official Gazette of the United States Patent Office, Vol 1060, No 4, p 1711, November 26, 1985.

Descriptors: *Patents, *Wastewater treatment, *Oil recovery, *Slurries, *Foam separation, *Separation techniques, Soaps, Flotation, Industrial wastes, Domestic wastes, Potassium compounds, Sodium compounds.

Oil is separated from slurry waste using foaming treatment. A saponifying agent is added to the slurry to saponify the oil or fat in the slurry. The slurry is stirred to cause foaming and surfacing of the oil and fat. The foam is separated to reduce the oil content of the slurry. The saponifying agent is selected from a group consisting of potassium hydroxide and sodium hydroxide in an amount of 1/100 to 1/30 parts by weight based on the amount of organic substances in the slurry. The separated oil is suitable for reuse and the slurry waste can be easily treated for disposal. (Cremmins-AEPCO)
W88-04731

PROCESS FOR REMOVING MULTIVALENT METALS FROM WASTE EFFLUENTS,
GTE Products Corp., Stanford, CT.
M.H. Hawxhurst, and W. W. Slobbe.
U.S. Patent No. 4,321,149, March 23, 1982, 4 p. Official Gazette of the United States Patent Office, Vol 1016, No 4, p 1333, March 23, 1982.

Descriptors: *Patents, *Wastewater treatment, *Chromium, *Iron, *Waste recovery, Hydrogen ion concentration, Effluents, Hydrogen peroxide.

Multivalent iron and chromium are removed from aqueous waste effluents using inexpensive raw materials. The metals are reduced to their valence by adding an excess of hydrogen peroxide in the presence of greater than the stoichiometric equivalent amount of an organic compound that is a stronger reducing agent than divalent chromium. The pH is maintained below about 6. A sufficient amount of a reactive metal hydroxide source is added to form the multivalent metal hydroxide with the metal in its lowest valence state and to increase the pH above about 7. The resulting multivalent metal hydroxide solids are then removed from the aqueous effluent. (Cremmins-AEPCO)
W88-04732

SEPTIC LEACHING SYSTEM,
S. P. Dix.
U.S. Patent No. 4,303,350; December 1, 1981, 9 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1013, No 1, p 175, December 1, 1981.

Descriptors: *Patents, *Septic wastewater, *Wastewater treatment, *Leaching, *Effluents, Pervious soils, Sumps.

A septic leaching system contains different leach fields. A first leach field contains an input, a porous bed, a system for distributing effluent from the input throughout the bed, and a layer of wicking material covering the bed. A second leach field at about the same elevation as the first one consists of an inlet, a pervious bed, a system for distributing effluent from the inlet throughout the bed, and a layer of wicking material covering the bed. The distribution system comprises an intake coupled to the source of septic effluent for selectively feeding the effluent to the input until the effluent level reaches a predetermined depth and then responsively and automatically feeding the effluent to the inlet. The system can be extended to three or more leach fields. (Cremmins-AEPCO)
W88-04733

EXTRACTION OF REUSABLE WATER FROM A MINERAL MINING PROCESS,
W. T. Gleim.
U.S. Patent No. 4,311,596; January 19, 1982, 5 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1014, No 3, p 1012, January 19, 1982.

Descriptors: *Patents, *Reclaimed water, *Water reuse, *Wastewater treatment, *Industrial water, *Mine wastes, *Potable water, Slime, Effluents, Sand, Surfactants, Flocculation, Asphalt, Clay minerals, Solvents.

Clay slime effluents from a tar sand extraction process are treated to extract reusable potable and industrial water. The pH of the effluent is reduced to an acidic pH to allow flocculation of the solid asphaltic material entrained within the slime using an anionic surfactant. A solution of chlorinated hydrocarbon and a solvent are added to the flocculated effluent slime so that physical layers of water, asphaltics in the solvent solution, and clay are formed upon centrifuging. (Cremmins-AEPCO)
W88-04734

METHOD OF CLARIFYING PROTEINACEOUS WASTE WATER CONTAINING SOLID IMPURTIES,
Silverton Tannery Ltd., Pretoria (South Africa).
S. D. Roets.
U.S. Patent No. 4,559,146; December 17, 1985. 6 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1061, No 3, p 1194, December 17, 1985.

Descriptors: *Patents, *Wastewater treatment, *Solid wastes, *Clarification, *Foam separation, *Coagulation, Proteins, Industrial wastes, Municipal wastes, Recirculated water, Aeration.

Proteinaceous wastewater is fed into a treatment zone for clarification. Solid impurities are coagulated and a portion of the clarified product is recirculated and aerated to form a foam, which is mixed with the wastewater feed in or upstream of the water treatment zone. The foam floats on the water surface before it and the coagulated solids are entrapped. The surfactants used in the foam production are reduced by recirculating 20 to 50% of the wastewater feed and aerating the recirculated clarified product to form a foam, which is continuous and comprises no less than 90% by volume of air. (Cremmins-AEPCO)
W88-04736

WASTEWATER PURIFICATION BY SOLVENT INDUCED PRECIPITATION USING FREEZE TECHNOLOGY TO RECOVER SOLVENT,
CBI Industries, Inc., Plainfield, IL.
Y. Selcukoglo, J. Richardson, and W. Schoerner.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116744/AS. Price codes: A04 in paper copy, A01 in microfiche. Final Report (1987). 57 p, 15 fig, 6 tab. Contract No. USGS 14-08-0001-G1307.

Descriptors: *Wastewater treatment, *Solvent precipitation, *Freeze technology, *Organic solvents, Sulfates, Pilot plants, Salts, Salt precipitation, Solvents, Ethanol, Freeze separation process, Vacuum filters, Crystallization.

A method of treating strong aqueous hazardous wastewaters by combining solvent induced precipitation and freeze technology has been experimentally evaluated. The process involves the addition

of a miscible organic solvent to an aqueous stream to lower the solubility of salts present in that stream. Precipitates are then separated from the solution, and the remaining brine is subjected to an indirect freeze system. The freeze process removes clean water as ice and concentrates the solvent laden brine for recycling to the system. Laboratory tests were performed on a mixture of synthetic wastewater and common solvents to determine freezing point depressions, solubilities, and effectiveness in inducing precipitation of salts. Precipitates formed were sulfates of sodium and calcium. Nitrates, chloride, and magnesium ions were not precipitatable. From these tests, ethanol was selected for use in a full pilot plant simulation. A pilot plant utilizing CBI's indirect freeze separation process, crystallizer, and vacuum filter was assembled and operated using the same synthetic wastewater. The test results indicated an acceptable solvent loss of 1.24% of the feed rate. During stable operation, 68% of the salts in the incoming feed stream was precipitatable but with improved separation technique it is estimated that 80% of the salts would precipitate. (Robinson-USGS)
W88-04748

ZEOLITE AMMONIA REMOVAL FROM CATFISH POND WATERS,
Mississippi Univ., University. Dept. of Geology and Geological Engineering.
R. Reynolds, and C. W. Williford.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116801/AS. Price codes: A03 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Interim Report G1234-05, July 1987. 27 p, 17 fig, 5 tab, 3 ref. Contract No. 14-08-0001-G1234. Project No. USGS G1234-05.

Descriptors: *Wastewater treatment, *Zeolite, *Ammonia, *Ion exchange, Catfish ponds, Water purification, Conservation, Clinoptilolite, Cation exchange capacity.

Catfish farming in the State of Mississippi is reaching a production state that will consequently require the construction of new 20 acre ponds. Each new pond will require 61 million gallons of water annually. This means a considerable increase in pumpage demands on groundwater sources. Because of present pumpage demand, the water table in the delta region has been lowered up to nine feet since 1981. Increasing the fish density in existing ponds rather than building new ponds is a possible solution. However, this solution would create another problem; ammonia buildup to toxic levels. This research is focused on developing a zeolite filtration system which will prevent toxic ammonia build-up in catfish ponds. Zeolites are ion exchangers and some natural species are capable of selectively removing ammonia from various types of water systems. Six different species of natural zeolite, 36 samples total, were analyzed for ammonia cation exchange capacity (CEC) and slake-durability, which is the internal strength of material when placed in a liquid. Ideally, the most effective zeolite would have the highest ammonia CEC and the highest slake-durability index. The zeolite mineral clinoptilolite presently being mined at Death Valley Junction, CA, was found to be the most suitable. This clinoptilolite has an average ammonia CEC of 218 milliequivalent per 100 grams and a slake-durability index of 98 percent. It comes to equilibrium with ammonia in one day, has an exchange rate of 50 to 60 bed volumes per hour and can be regenerated in sodium chloride within 2 to 3 hours. (Reynolds-U. MS)
W88-04755

TUBULAR MEMBRANE SEPARATION PROCESS AND APPARATUS THEREFOR,
Hitachi Ltd., Tokyo (Japan).
For primary bibliographic entry see Field 3A.
W88-04786

SURFACE AERATING ROTOR,
J. R. Kaelin.
U. S. Patent No. 4,322,377; March 30, 1982, 6 p, 6 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1016, No 5, p 1724, March 30, 1982.

Descriptors: *Patents, *Aeration, *Wastewater treatment, *Rotors, *Surface water, Water circulation, Aerators, Flow control, Flow regulators.

A surface aerating rotor contains an intake zone for circulating and aerating water, particularly in wastewater treatment plants. Each rotor vane in conjunction with at least one flow guide wall forms a fluid throughput unit, having an entry side that operationally is below the water surface and an exit side that operationally is primarily above the water surface. The fluid throughput units are detachably connected to the supporting assembly, and the connecting point between each unit and the supporting assembly is designed to permit the vane exit angle to be adjusted. A wedgeshaped intermediate piece allows the height of each unit to be individually adjusted. (Cremmins-AEPCO)
W88-04790

DEVICE FOR DISPERSING A LIQUID IN A GAS PHASE,
C. Brucker.
U. S. Patent No. 4,358,413; November 9, 1982, 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1024, No 2, p 636, November 9, 1982.

Descriptors: *Patents, *Wastewater treatment, *Aeration, *Sludge conditioning, Pumps, Aerators, Nozzles, Spraying, Tubes, Water tanks.

Liquid confined in wastewater treatment bed or tank is dispersed in the gas phase by spraying it upward. The dispersion device comprises a pump that is partly submerged in the liquid between a flared suction tube and a delivery nozzle, in combination with a driving motor. A primary flared suction tube is located near the bottom of the tank. The delivery nozzle is located near the liquid-gas interface, and a duct of a height adaptable to the depth of the liquid is provided between them. The pump is submerged near the flared suction tube. A secondary flared tube is arranged externally and concentrically with the primary flared tube. The rising flow of liquid through the primary tube creates a secondary rising flow using drag. The latter flow mingles with the primary flow downstream of the pump. (Cremmins-AEPCO)
W88-04792

PROCESS AND APPARATUS FOR MIXING A GAS AND A LIQUID,
Union Carbide Corp., Danbury, CT.
L. M. Litz.
U. S. Patent No. 4,454,077; June 12, 1984, 5 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1043, No 2, p 747, June 12, 1984.

Descriptors: *Aeration, *Patents, *Wastewater treatment, *Impellers, *Oxygenation, *Activated sludge, Baffles, Vortices, Turbulent flow, Mixing.

A mechanical apparatus creates a gas-liquid mixture with a body of liquid in sewage treatment systems that use oxygen in the activated sludge process. The apparatus includes a vessel and a cylindrical hollow draft component open at both ends and having a theoretical axis running from end to end. The axis is vertical and the draft component is conically flared. An axial flow down-pumping impeller is connected to a rotatable shaft and positioned within the draft tube. The shaft corresponds in position to the axis. The diameter of the impeller is less than but approximates that of the draft tube. A vortex and turbulence are created in a baffle and gas is drawn into the vortex. A liquid velocity of at least one foot per second is achieved, the turbulence is increased, and a second baffle below the impeller and a high shear zone between the impeller and the second baffle are provided. (Cremmins-AEPCO)
W88-04793

ION EXCHANGE TREATMENT FOR REMOVING TOXIC METALS AND CYANIDE VALUES FROM WASTE WATERS,
L. G. Carlson.
U. S. Patent No. 4,321,145; March 23, 1982, 12 p, 9 fig, 1 tab. Official Gazette of the United States Patent Office, Vol 1016, No 4, p 1332-1333. March 23, 1982.

Descriptors: *Toxic wastes, *Hazardous wastes, *Patents, *Ion exchange, *Wastewater treatment, *Waste recovery, *Cyanide, *Heavy metals, *Metal-fishing wastes, Resins, Toxicity, Industrial wastes.

Toxic metals are removed and cyanide is recovered from plating baths and other wastewaters using ion exchange treatment. A multilayered ion exchange resin bed generally maintains its characteristics, with both anionic and cationic resin bead layers remaining within their discreet layers, while the bed is in the loading stage and during most phases of the regeneration stage. Rinsing liquids, acidic and basic regeneration solutions, and air are moved sequentially to control bed disturbance, while the multilayered bed is thoroughly and rapidly regenerated. The bed is well suited for removal of multivalent, especially bivalent, heavy metal ions and cyanide from plating bath waste streams. Additionally, the cyanide containing rinsing streams flowing from the multilayered bed are subject to treatment to react the cyanide values with caustic to recover cyanide salt liquor suitable for reuse within a cyanide plating bath. (Cremmins-AEPCO)
W88-04798

SEWAGE-AERATION SYSTEM, AND METHOD FOR THE OPERATION AND USE THEREOF,
J. R. Kaelin.
U. S. Patent No. 4,666,611; May 19, 1987, 7 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1078, No 3, p 1644, May 19, 1987.

Descriptors: *Patents, *Wastewater treatment, *Aerators, *Rotors, *Liquid sludge, *Aeration, Flow control, Wastewater facilities, Water conveyance, Surface water, Water tanks.

A surface aeration rotor for circulating and aerating sewage comprises a carrier connected to a vertical drive shaft and liquid conveying units. The units are secured to the carrier and contain at least one scoop associated with two flow control walls. The scoops are disposed in a plane which is twisted and curved in the direction of the radial plane of the rotor allowing the liquid jets to exit the rotor edgewise. The angle of attack of the upper outlet side is between 60 and 105 degrees and that of the lower inlet side is between 0 and 50 degrees. The scoop inlet sides are at least 1.2 times as long as the outlet sides, and the angle between the scoop and the upper and the lower flow guiding walls is between 60 and 120 degrees (Cremmins-AEPCO)
W88-04799

SELF-PROPELLED JET AERATOR,
Georgia Tech Research Corp., Atlanta.
B. M. Khudenko.
U. S. Patent No. 4,482,510; November 13, 1984, 6 p, 5 fig, 2 ref. Official Gazette of the United States Patent Office, Vol 1048, No 2, p 765, November 13, 1984.

Descriptors: *Patents, *Aerators, *Wastewater treatment, *Water treatment, Pumping, Jets, Orifices, Pontoons, Clogging, Ice, Mass transfer, Mixing, Aeration, Oxygen, Ammonia, Hydrogen sulfide.

Self-propelled jet aerators dissolve oxygen and other gases to strip ammonia, hydrogen sulfide, volatile organics, and other volatile products from water and wastewater. The aerators comprise a floating structure supported by pontoons on the water. The structure includes a water compartment supported by the pontoons. An orifice in the outer wall of the water compartment discharges water jets in the direction opposite to that of the rotation of the pontoon and also sideways. Water is supplied to the water orifice from the water compartment. A guide secured to the pontoon guides the floating structure in a helical path. The device

contains components for the prevention of icing and clogging. (Cremmins-AEPCO)
W88-04800

CONTINUOUS PROCESS FOR THE RECLAMATION OF WASTE DRILLING FLUIDS,
Newpark Waste Treatment Systems, Inc., Metairie, LA.
C. Shiver.
U. S. Patent No. 4,482,459; November 13, 1984, 9 p, 6 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1048, No 2, p 751-752, November 13, 1984.

Descriptors: *Patents, *Wastewater treatment, *Drilling fluids, *Oil recovery, *Oil wastes, Waste recovery, Slurries.

A waste drilling fluid slurry suitable for environmental discharge in a liquid or solid cake state is rendered from oil wells containing cuttings, formation fluid solids, and liquids. Uphole drilling fluids are conducted to a continuous flow process having a slurry surge tank for chemical conditioning by addition of an inorganic acidic coagulant, which permits settling and thickening. The thickened mud slurry is sent to a primary solids separation unit where an organic flocculant is added to aid flocculation of the solids. The resulting water is sent to a secondary solids removal unit, and solids recovered are chemically conditioned and reintroduced to the primary solids separation unit. The water from this step is sent to a chemical oxygen demand reduction unit having a carbon adsorption unit for removal of organic substances or to a reverse osmosis unit for removal of organic substances and dissolved solids. The treated solids are disposed as landfill. (Cremmins-AEPCO)
W88-04801

FLOATING PLATFORM AERATOR/MIXER APPARATUS,
General Signal Corp., Stamford, CT.
I. H. Nicholas.
U.S. Patent No. 4,581,181; April 8, 1986, 6 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1065, No 2, p 823, April 8, 1986.

Descriptors: *Patents, *Aerators, *Mixing, *Wastewater treatment, Impellers, Flotation, Platforms, Ballast, Wastewater facilities.

An aerator/mixer floating platform mooring structure allows vertical movement of the platform when the liquid level changes and prevents rocking or horizontal movement. The floating platform structure comprises a framework mounted on ballast tanks adapted to maintain the platform at a designated height above the level of liquid in a tank. Tubular guides are mounted on the platform framework extending at right angles to frame members. The guide members are slidably disposed on mooring posts. Each guide is provided with a series of longitudinally spaced apart sets of rollers for resilient, rolling engagement with the mooring post on which it is disposed. (Cremmins-AEPCO)
W88-04802

METHOD AND APPARATUS FOR AERATION OF WASTEWATER LAGOONS,
J. M. Eaton.
U.S. Patent No. 4,681,711; July 21, 1987, 9 p, 9 fig. Official Gazette of the United States Patent Office, Vol 1080, No 3, p 1446, July 21, 1987.

Descriptors: *Patents, *Aerators, *Wastewater treatment, *Aerated lagoons, *Ponds, Bubbles, Oxygenation, Mixing, Impellers, Rotational flow.

Aeration of wastewater lagoons yields increases in the zone of influence and the amount of oxygen transferred to the wastewater per horsepower of energy expended. Minute air bubbles are introduced into a wastewater pond or lagoon and mixed throughout a large zone of influence by rotating an impeller having symmetrical radial vertical vanes below the surface of the wastewater. An air vortex is produced and drawn downward into vacuum regions produced between the vanes as a result of centrifugal expulsion of the wastewater. The air and water drawn into the vacuum regions are sheared, causing a high degree of mixing of the inflowing wastewater and air. The water and air bubble mixture is centrifugally expelled by the impeller, creating a radial outward subsurface current. An air screw is disposed on a shaft supporting the impeller, with fins that enhance the flow of air downward through the vortex into the vacuum. The impeller shaft is driven by an electric motor and gear reduction assembly. (Cremmins-AEPCO)
W88-04803

WASTE SOLVENT RECOVERY APPARATUS,
Verbatim Corp., Sunnyvale, CA.
S. Majicek, and F. A. Fitz.
U. S. Patent No. 4,317,722; March 2, 1982, 5 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1016, No 1, p 166, March 2, 1982.

Descriptors: *Patents, *Wastewater treatment, *Waste recovery, *Solvents, Jets, Steam, Condensers, Particulate matter, Vaporization.

Tetrahydrafuran (THF) is recovered from waste sludge using a cylindrical container adapted to receive a jet of solvent laden sludge. Steam jets are directed into the sludge stream. A condenser and an exit orifice are located on the top of the cylindrical container and a door for removal of waste particulates is located in the lower portion. Waste sludge is forced out of the orifice, and steam directed at the sludge jet causes a fine particulate dustlike material to be generated as residue at the bottom of the container. The THF is vaporized by water vapor and rises into the condenser column on top of the container. The rates of sludge entry into the container and steam flow are adjusted so that the temperatures at the bottom and top of the container are greater than the boiling point of THF and less than the boiling point of water, respectively. (Cremmins-AEPCO)
W88-04805

HYDRAULIC HORIZONTAL MIXER,
Air-O-Lator Corp., Kansas City, MO.
R. A. Cramer, and B. G. Cramer.
U. S. Patent No. 4,464,259; August 7, 1984, 6 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1045, No 1, p 285, August 7, 1984.

Descriptors: *Patents, *Wastewater treatment, *Aeration, *Aerators, *Hydraulic equipment, *Mixing, Equalizing basins, Storage tanks, Oxidation ditches, Propellers, Water circulation, Water tanks, Biodegradation.

A hydraulically powered mixing aerator circulates fluid in a sewage treatment plant and facilitates aeration. The mixing aerator can be easily adjusted to any depth within a tank and any horizontal angle or azimuth, and can be provided with an adjustable tilt angle. The aerator is powered by a submersible motor, which provides for low speed and torque rotation of a submersed propeller without the aid of a reduction gear. The aerator also can be easily and inexpensively controlled in speed of operation and mixing. The internally pressurized submersible motor is not subject to extensive damage from small leaks. (Cremmins-AEPCO)
W88-04806

ROTARY SURFACE AERATOR WITH ADJUSTABLE LIQUID TRANSPORTING UNITS,
J. R. Kaelin.
U. S. Patent No. 4,465,645; August 14, 1984, 5 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1045, No 2, p 762-763, August 14, 1984.

Descriptors: *Patents, *Wastewater treatment, *Aerators, *Rotors, *Aeration, Surface flow, Water transport, Propellers, Oxygenation.

A rotary surface device for aerating sewage contains a carrying part connected to a vertically running driving axle. The carrying part has pairs of liquid transporting units fastened to it and each unit has at least one scoop and current guide wall. During operation, the inlet and outlet sides of the unit are below and at least primarily above the sewage surface, respectively. Each scoop is provided with outlet edges. The edges and the liquid transporting units are adjacent in a circumferential direction and are spaced at different distances from the drive axle of the aeration device. Each pair of liquid transporting units is arranged about a rotatable vertical axle of the carrying part. The units are located on a common pivot bracket having separate brackets for each unit so that can be adjusted about the vertical axle of the carrying part. (Cremmins-AEPCO)
W88-04807

APPARATUS FOR MIXING AIR AND LIQUID,
J. H. Haegeman.
U. S. Patent No. 4,468,358; August 28, 1984, 6 p, 5 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1045, No 4, p 1705 - 1706, August 28, 1984.

Descriptors: *Patents, *Biological wastewater treatment, *Aeration, *Aerators, *Oxygenation, *Mixing, Wastewater treatment, Impellers, Propellers, Surface flow, Activated sludge.

A high speed surface aerator provides oxygen transfer for biological wastewater treatment. The aerator impeller fitted on the motor comprises a lower part shaped as a screw-propeller pump and an upper part shaped as a centrifugal paddle wheel or impeller with blades which gradually impart horizontal movement to the liquid stream. Optimum efficiency is obtained with very low and low-load activated sludge systems by increasing the size of the screw propeller pump and reducing the size of the centrifugal impeller; with medium-load systems by adopting almost equivalent sizes for the two impeller parts; and with high-load systems by increasing the size of the centrifugal impeller and reducing the size of the screw propeller. (Cremmins-AEPCO)
W88-04808

METHOD FOR OPERATING A BIOLOGICAL SEWAGE PURIFICATION PLANT,
Otto (Dr. C.) und Co. G.m.b.H., Bochum (Germany, F.R.).
A. Birkner.
U. S. Patent No. 4,406,790; September 27, 1983, 3 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1034, No 4, p 1612-1613, September 27, 1983.

Descriptors: *Patents, *Wastewater treatment, *Aeration, *Sewage bacteria, Biological wastewater treatment, Water tanks, Heating, Steam, Decomposition.

Optimum bacterial growth and decomposition conditions are maintained in the aerating tank of a biological sewage purification plant at all times of the year, irrespective of the external ambient temperature, by feeding a heating medium, preferably steam, onto the surface of the sewage present in the tank such that the steam is distributed uniformly over the entire surface of the sewage. The amount of heating medium supplied is metered based on the temperature of the water in the aerating tank. The water to be treated is aerated in a tank containing bacteria using a rotating impeller, or the like. Steam is supplied onto the surface of the sewage by an annular distributor pipe, which is located above an aerating impeller and provided with orifices which direct the steam. The steam accumulates like a layer of mist above the surface, and in spite of the existence of cold ambient air, the contents of the tank undergo practically no cooling. (Cremmins-AEPCO)
W88-04809

PULSED REGENERATION OF ADSORPTION COLUMN,
Westvaco Corp., New York.
D. G. Hager, M. L. Massey, and F. Rubel.
U. S. Patent No. 4,462,904; July 31, 1984, 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1044, No 5, p 2060-2061, July 31, 1984.

Descriptors: *Patents, *Wastewater treatment, *Activated carbon, Adsorption, Sterilization, Adsorbents, Regeneration.

A substantially continuous activated carbon adsorption system minimally requires one mild steel adsorption vessel and a pair of smaller stainless blow cases for on-site carbon washing, sterilization, and regeneration, as well as carbon transfer. An up-flow carbon adsorption bed allows periodic or pulsed removal of a fractional percentage of the entire carbon bed charge. Sequentially following the periodic removal of a spent carbon increment from the bottom or influent face of the bed a fresh or regenerated carbon increment of substantially the same size is deposited on the top or effluent face of the bed. The spent carbon increment is fluid transported through connective piping from the adsorption vessel bottom to the interior of a first of two small, stainless steel blow cases. The charged blow case is then isolated from the adsorption vessel by valve closures and a sterilization and regeneration medium. The sterile and regenerated carbon charge is blown under pneumatic or hydraulic pressure from the other blow case. (Cremmins-AEPCO)
W88-04810

TREATING LIQUIDS IN TANKS,
E. A. Seymour.
U. S. Patent No. 4,541,928; September 17, 1985, 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1058, No 3, p 1274, September 17, 1985.

Descriptors: *Patents, *Mixing, *Water tanks, *Water transport, *Wastewater treatment, *Aeration, Chemical treatment, Bubbles, Water circulation.

Liquid is circulated in sewage plants and chemical process tanks by moving it vertically beside a tank wall. The reaction of the liquid on the wall surface gives it a horizontal velocity away from the wall. In a closed tank, the liquid circulates by refilling it at a position remote from the wall and returns to the bottom of the tank. In a deep tank, the circulating path can be in a vertical plane normal to the wall. An improved mixing effect can be achieved in shallow tanks by moving the liquid away from the wall in a nonuniform flow across the tank. When the horizontal component of velocity of the liquid normal to the wall is stronger at one end of the tank, the liquid tends to swing towards the end of the tank with the lower horizontal component of velocity so that it circulates horizontally as well as vertically and can return at the other side of the tank. Thus the circulating path extends to all regions of the tank and good mixing is achieved. A bubble curtain is an efficient means of lifting the liquid. (Cremmins-AEPCO)
W88-04811

PROCESS FOR PURIFYING WATER,
M. R. Lyon.
U. S. Patent No. 4,340,487; July 20, 1982, 7 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1020, No 3, p 999-1000, July 20, 1982.

Descriptors: *Patents, *Wastewater treatment, *Flotation, *Industrial wastewater, *Municipal wastewater, Flocculation, Biological oxygen demand, Suspended solids, Oil wastes, Aeration, Metal-finishing wastes.

Suspended solids, biological oxygen demand, fat, and oil are removed from wastewater from a rendering or hide process in which much of the fat and settled solids were removed previously. The wastewater is pH adjusted or buffered, aerated, treated with flocculation agent, and allowed to separate into a low suspended solids phase and a high wet solids phase. The wet solids are delivered to a continuous-belt filtration system. The liquids are removed and a solid cake is formed. Material which tends to plug the filter bed is washed by a stream of substantially non-flocculated wastewater, which is returned to the vicinity of the start of the process. Other processes which could be treated using this system include metal finishing and metal plating operations. (Cremmins-AEPCO)
W88-04818

FLOTATION PROCESS FOR PURIFICATION OF WASTEWATER,
Brown, Boveri und Cie A.G., Baden (Switzerland).
E. Julke.
U. S. Patent No. 4,311,595; January 19, 1982, 4 p. Official Gazette of the United States Patent Office, Vol 1014, No 3, p 1012, January 19, 1982.

Descriptors: *Patents, *Wastewater treatment, *Flotation, *Industrial wastewater, *Municipal wastewater, *Electrolysis, *Oil wastes, Polymers, Decomposition.

An electroflotation process is used to remove impurities from oil-containing wastewater in contact with an electrode surface and to inhibit the formation of oil films on the surface. After the wastewater is electrolyzed an ascending stream of gas bubbles is produced. The electrolysis occurs in the presence of wettable particles of a polymeric material that is practically insoluble in water and has an absolute density no greater than 1.3 g/cu cm. The wettable particles are entrained in the ascending stream of bubbles so as to rise to the surface of the wastewater along with the impurities. The particles are removed from the surface and reintroduced into the wastewater for treatment after cleaning of a portion of the impurities including oil. (Cremmins-AEPCO)
W88-04819

PROCESS FOR SEPARATING SOLIDS FROM LIQUID MATTER,
Hoechst A.G., Frankfurt am Main (Germany, F.R.).
D. Disselbeck, and R. Richter.
U. S. Patent No. 4,289,628; September 15, 1981, 3 p. Official Gazette of the United States Patent Office, Vol 1010, No 3, p 1130-1131, September 15, 1981.

Descriptors: *Patents, *Wastewater treatment, *Separation techniques, *Gravity filters, *Solid wastes, *Liquid wastes, Filtration, Biological oxygen demand, Alluvium, Bubbles, Sludge.

Solids are separated from liquids in wastewater by gravity. A gas is fed into a liquid medium from which solid particles are to be separated. Gas bubbles accumulate on the solid particles. The liquid medium is introduced into a three dimensional filter element to form a column of the liquid medium in the element. The gas particles float to the upper level of the column and form a layer of particles on its upper surface. The liquid matter passes through the sides and bottom of the filter element while continuously building alluvial filter layers of the solids on the internal surface of the filter element. The layers are built from the bottom upwards along the filter wall relative to the rising level of the liquid medium in the filter element. The process decreases the biological oxygen demand. (Cremmins-AEPCO)
W88-04820

PREPARATION OF AN ANIMAL FEED SUPPLEMENT FROM FISH CANNERY PROCESS WASTEWATER,
Star-Kist Foods, Inc., Terminal Island, CA.
V. J. Evich, G. C. Brown, and H. J. Dunn.
U. S. Patent No. 4,282,256; August 4, 1981, 6 p, 1 fig, 5 tab. Official Gazette of the United States Patent Office, Vol 1009, No 1, p 279, August 4, 1981.

Descriptors: *Patents, *Recycling, *Wastewater treatment, *Food-processing wastes, *Waste recovery, *Feeds, Industrial wastewater, Fish, Sludge, Flotation, Aeration, Dewatering, Sludge drying.

Animal feed is recovered from fish cannery wastewater by using the sludge separated in a flotation cell treatment of the wastewater as an additive. Aerated wastewater is separated, in the presence of a polyionic polymer and a flocculating agent, into a sludge fraction concentrated in fat and protein, a clarified water fraction, and a grit fraction. The separated sludge fraction is aerated and then dewatered by centrifugation in the presence of a second polyionic polymer with substantially the opposite charge of the first polymer. An antioxidant is added to the sludge to prevent oxidation of lipids. The sludge is dryed under vacuum at a low temperature while blending with an absorptive, animal-edible bulk carrier solid in volumetric proportions from about 1:4 to 1:1 parts carrier to sludge solids to produce an animal feed supplement as a dry particulate solid. (Cremmins-AEPCO)
W88-04821

PROCESS AND EQUIPMENT FOR ULTRASONIC CONDITIONING OF SEWAGE SLUDGES,
A. Toth, E. Toth, J. Olah, J. Bitskey, and L. Bulkai.
U. S. Patent No. 4,340,488; July 20, 1982, 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1020, No 3, p 1000, July 20, 1982.

Descriptors: *Patents, *Wastewater treatment, *Ultrasonics, *Sludge conditioning, Flotation, Separation techniques, Sterilization, Dewatering, Filtration, Decomposition, Vibrations.

Ultrasonic sludge conditioning treatment includes feeding the sludge to a tank and applying ultrasonic vibration. The sludge is then fed to a flotation tank. Solids are separated from the ultrasonic-treated sludge in the tank by flotation of the material to the surface. An inorganic chemical coagulating agent is added to the sludge in the first tank after the sludge is decomposed to a dispersed homogeneous colloidal mass by the ultrasonic treatment. The dwell time of the sludge in the first tank is about 10 minutes and the dwell time of the ultrasonic treated material in the flotation tank is about 5 to 10 minutes. (Cremmins-AEPCO)
W88-04823

PROCESS FOR CLARIFYING ALGAE-LADEN WASTEWATER STREAM,
Olin Corp., New Haven, CT.
D. A. Shermer, P. P. Jim, and D. R. Laurance.
U. S. Patent No. 4,330,407; May 18, 1982, 7 p, 2 fig, 2 ref. Official Gazette of the United States Patent Office, Vol 1018, No 3, p 1017, May 18, 1982.

Descriptors: *Patents, *Wastewater treatment, *Clarification, *Algae, Aeration, Coagulation, Clarified wastewater, Suspended solids, Sludge, Effluent streams.

Algae-laden wastewater is clarified to form waste sludge and an effluent water stream containing less total suspended solids. The wastewater stream is deaerated to remove some of the gaseous oxygen attached to the algae. The stream is then passed through a substantially light-free environment for a sufficient time to cause a major portion of the algae to revert to the nocturnal phase. At least one coagulation aid is added to the stream containing algae in the nocturnal phase to cause coagulation of the suspended solids while in a substantially light-free environment; and the coagulated solids in the stream are settled in the light-free environment to form a waste sludge of coagulated solids and an effluent water stream having a markedly lower amount of suspended solids. (Cremmins-AEPCO)
W88-04831

PROCESS AND APPARATUS FOR THE CHEMICAL-MECHANICAL TREATMENT AND PURIFICATION OF GROUNDWATERS, SURFACE WATERS AND EFFLUENTS,
Passavant-Werke Michelbacher Huette, Aarbergen (Germany, F.R.).
G. Von Hagel, N. Berlenbach, and G. Werner.
U. S. Patent No. 4,388,195; June 14, 1983, 8 p, 2 fig, 1 tab. Official Gazette of the United States Patent Office, Vol 1031, No 2, p 609-610, June 14, 1983.

Descriptors: *Patents, *Wastewater treatment, *Groundwater, *Surface water, *Effluents, *Water treatment, Coagulation, Flocculation, Chemical precipitation, Sedimentation, Hydrogen ion concentration, Sludge conditioning, Separation techniques.

Groundwater, surface water, and effluents are treated and purified by coagulation, flocculation, and precipitation using agents conducive to sedimentation and altering of the pH value. In four initial processing stages, materials, flocculant aids, and contact sludge are admixed and sedimentable flocs and settleable conglomerations of particles are formed together with adsorbed, attached, and occluded raw water components. A second process stage includes the separation of the flocs, reaction products, and raw water components from the clarified water using inclined plate sedimentation equipment and including concentrating a part of the sludge to a solids concentration of at least 1% weight/volume and returning part of the concentrated sludge as the contact sludge into the second initial process stage. (Cremmins-AEPCO)
W88-04832

AGENT FOR THE PURIFICATION OF WASTE WATERS AND PROCESS FOR ITS PRODUCTION,
Colloid Piepho, Wilmington, DE.
R. F. Piepho.
U. S. Patent No. 4,415,467; November 15, 1983, 6 p, 8 tab. Official Gazette of the United States Patent Office, Vol 1036, No 3, p 1065-1066, November 15, 1983.

Descriptors: *Patents, *Wastewater treatment, *Oil wastes, *Emulsions, *Industrial wastes, Adsorption, Encapsulation, Coagulation, Leaching, Oil recovery, Flocculation, Acids, Bentonite.

A chemical composition adsorbs and encapsulates large quantities of wastewater contaminants, particularly emulsified oily wastes, and encapsulates them to prevent leaching back into the wastewater. The composition includes an acid, such as adipic acid; a coagulant, such as aluminum sulfate; an activated bentonite; and lime, CaO or Ca(OH)2, and bentonite containing at least about 5% by weight calcium aluminum silicate. The composition may include a polymeric flocculating agent for flocculation of the encapsulated activated bentonite, or the flocculating agent may be added to the wastewater separately, after encapsulation. (Cremmins-AEPCO)
W88-04834

DEWATERING OF PETROLEUM-CONTAINING SLUDGES WITH RECOVERY OF THE OIL COMPONENT,
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
B. Sander, F. Hovemann, and K. Scherling.
U. S. Patent No. 4,417,976; November 29, 1983, 7 p, 1 tab, 1 ref. Official Gazette of the United States Patent Office, Vol 1036, No 5, p 1930-1931, November 29, 1983.

Descriptors: *Patents, *Wastewater treatment, *Oil wastes, *Oil recovery, *Dewatering, *Sludge drying, Industrial wastes, Flocculation, Filtration, Additives, Gravity filters.

Petroleum-containing sludges are dewatered and oil is recovered using finely divided additives and organic flocculants. The additives, which are homogeneously dispersed in the sludge, are selected from the group consisting of ash, coal, sand, or mixtures of these, in a free-flowing form or as an aqueous suspension, in an amount such that the total solids content of the mixtures is from 10 to 30% by weight. The sludge is treated with an aqueous solution of an organic flocculant. Most of the sludge water is removed by gravity filtration and the pre-dewatered sludge is treated with an aqueous solution of aluminum salts or trivalent iron salts. The resulting mixture is pressure filtered to separate the petroleum and water from the solids. (Cremmins-AEPCO)
W88-04835

DECANTS OF TAILINGS DAMS,
D. A. Piesold.
U. S. Patent No. 4,344,720; August 17, 1982, 7 p, 6 fig. Official Gazette of the United States Patent Office, Vol 1021, No 3, p 923, August 17, 1982.

Descriptors: *Patents, *Mine wastes, *Spoil banks, *Dams, *Reservoirs, *Wastewater treatment, Slurries, Pipes, Pipe flow, Conveyance structures, Compressible flow.

Destruction of decants of tailings dams is prevented by constructing them in the form of a pipe, which is formed as a coil with axially spaced turns one above the other. The end of the bottom turn is connected to a laterally extending water outlet pipe or other duct and the end of the top turn is open for the flow into it of water from the dam. The turns are sized in relation to the cross-sectional area and wall thickness of the pipe from which they are formed so that the coil is compressed axially. Thus, when the dam is operating, tailings are consolidated around the decant, without overstressing the pipe. The decant effectively forms a coiled compression spring, which is compressed by the consolidation of the trailings as they build up on the bed of the dam around the decant. The compression occurs within the elastic limits of the pipe from which the spring is formed. (Cremmins-AEPCO)
W88-04839

WATER CLARIFICATION,
J. P. Lambert, and M. L'Huiller.
U. S. Patent No. 4,456,534; June 26, 1984, 5 p, 2 ref. Official Gazette of the United States Patent Office, Vol 1043, No 4, p 1607, June 26, 1984.

Descriptors: *Patents, *Wastewater treatment, *Polymers, *Flocculation, *Clarifiers, Clarified wastewater, Calcium chloride, Sodium hydroxide, Potassium compounds, Industrial wastewater, Separation techniques.

Wastewater containing one or more synthetic carboxylated styrene and butadiene copolymers in latex form or in admixture with other latex polymers is clarified using polymeric flocculants. The wastewater is agitated in a container for 3 minutes to 3 hours while a stream of calcium chloride is added sufficient to provide a concentration of 200 to 300 ppm based on the total water in the container. A liquid or aqueous stream of a cationic flocculant of about 10 to 50 ppm is also added to the container, along with an aqueous stream of calcium, potassium or sodium hydroxide to adjust the pH to 9 to 10. An aqueous stream of an anionic polymeric flocculant, generally characterized as a high molecular weight acrylamide-acrylic acid resin of medium anionic functionality of 3 to 10 ppm, is then added to the wastewater, which is passed to a separation system to separate the resulting aggregated polymeric material. (Cremmins-AEPCO)
W88-04840

ISOLATION OF 3-ISOPROPYL-2,1,3-BENZOTHIADIAZIN-4-ONE-2,2-DIOXIDE FROM WASTEWATER FROM ITS PREPARATION,
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
H. Hansen, H. Merkle, and A. Mueller.
U. S. Patent No. 4,451,378; May 29, 1984, 3 p. Official Gazette of the United States Patent Office, Vol 1042, No 5, p 2111, May 29, 1984.

Descriptors: *Patents, *Wastewater treatment, *Waste recovery, *Herbicides, *Chemical precipitation, Salts, Hydrogen ion concentration, Filtration.

3-Isopropyl-2,1,3-benzothiadiazin-4-one,2,2-dioxide (bentazone) is isolated from wastewater to remove the residual bentazone for application as a herbicide. The pH of the wastewater is adjusted to 7.5 to 9.5 and about 0.2 to 0.5% by volume of a 40 to 60% by weight aqueous solution of an alkali metal or ammonium salt of bentazone is added. The mixture is heated for about 15 to 30 minutes at 75 to 115 C then cooled to 5 to 30 C. The pH of the cooled mixture is adjusted to a range of 1 to 3, using a mineral acid, to precipitate the bentazone in a free form for its filtration. (Cremmins-AEPCO)
W88-04841

PROCESS FOR THE REMOVAL OF HEAVY METALS FROM AQUEOUS SOLUTION,
Talbot (Richard S.) and Associates, Inc., Media, PA.
R. S. Talbot.
U. S. Patent No. 4,423,880; February 21, 1984, 8 p, 2 tab, 1 ref. Official Gazette of the United States Patent Office, Vol 1039, No 3, p 1185, February 21, 1984.

Descriptors: *Patents, *Chemical precipitation, *Wastewater treatment, *Heavy metals, *Waste recovery, Sulfides, Solubility, Slurries, Suspension.

Heavy metals are removed from aqueous solutions, suspensions, or slurries using sulfide precipitation. An amount of soluble sulfide is added to precipitate at least one heavy metal to the limits of its metal sulfide solubility. The amount of soluble sulfide is less than the amount required to precipitate as the metal sulfide as least one other heavy metal in the aqueous system having a soluble sulfide equilibrium concentration sufficiently higher than that of the selected heavy metal. This permits selective precipitation of the metal and of any other heavy metals present having lower sulfide equilibrium solubility concentrations than that of the selected heavy metal. A portion of at least one heavy metal remaining in the system is then precipitated by a method other than sulfide precipitation to obtain a sulfide-free aqueous fluid. (Cremmins-AEPCO)
W88-04842

CONTROL OF ACTIVATED SLUDGE FILAMENTOUS BULKING: VII. EFFECT OF ANOXIC CONDITIONS,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Wanner, J. Chudoba, K. Kucman, and L. Proske.
Water Research WATRAG, Vol. 21, No. 12, p 1447-1451, December 1987. 4 fig, 8 tab, 9 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Bulking sludge, Sphaerotilus, Filamentous bulking, Anaerobic digestion, Nitrates, Respiration, Kinetics, Bacteria, Biological wastewater treatment.

The effect of anoxic conditions on the occurrence of filamentous organisms in mixed cultures was studied in laboratory activated sludge systems. It was demonstrated repeatedly that anoxic conditions can suppress the growth of some undesirable filamentous organisms, for instance, type 021N and Sphaerotilus natans. It was found also that severely filamentous mixed cultures had maximum rates of denitrification or nitrate respiration one order of magnitude lower than non-filamentous mixed cultures. On the basis of these findings it is concluded that some filamentous organisms cannot use nitrate nitrogen as an electron acceptor. (Author's abstract)
W88-04844

STEADY STATE MODELING OF REACTOR-SETTLER INTERACTION,
Technion - Israel Inst. of Tech., Haifa. Dept. of Chemical Engineering.
M. Sheintuch.
Water Research WATRAG, Vol. 21, No. 12, p 1463-1472, December 1987. 9 fig, 13 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Biological wastewater treatment, *Settling tanks, Excocellular polymer, Filaments, Steady state, Coexistence.

The interaction of a biological reactor and a settler was analyzed with coupling via mass balance, exocellular polymer production, or competition between flocculating and filamentous microorga-

nisms. Experimental information was reviewed and simple models were constructed to account for the necessary features of the interaction. The analysis revealed that chemical interaction should be correlated with sludge age; optimal operating conditions were derived. Biological interaction induces steady-state multiplicity or coexistence of the two species. The process of population shift is much slower than their growth and even pure population attain steady state very slowly or may never attain it. (Rochester-PTT)
W88-04846

DEMONSTRATION OF MASS TRANSFER AND PH EFFECTS IN A NITRIFYING BIOFILM,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. Siegrist, and W. Gujer.
Water Research WATRAG, Vol. 21, No. 12, p 1481-1487, December 1987. 9 fig, 1 tab, 12 ref, append.

Descriptors: *Wastewater treatment, *Trickling filter, *Biofilm, *Mass transfer, *Nitrification, *Hydrogen ion concentration, Bicarbonate, Ammonium, Oxidation, Diffusion coefficient, Mathematical model, Biological wastewater treatment.

A bench-scale nitrifying trickling filter (surface area = 0.5 sq m) was developed to permit evaluation of diffusion of oxygen within a biofilm, the pH dependence of ammonium oxidation, and external mass transfer. In addition, a biofilm model was developed and verified for homogeneous nitrifying biofilms of varied thickness and for thin nitrifying biofilms covered by heterotrophic biofilms (double-layer biofilms). The model uses literature values for the pH dependence of Monod coefficients for Nitrosomonas and Nitrobacter. The diffusion coefficient of oxygen in the biofilm was 40-80% of the value in pure water. Due to mass transfer resistance, the biomass 'sees' a lower pH than is measured in the water film passing over it. The surface uptake rate of ammonia is used as an indicator of pH gradients within the biofilm system. With the help of oxygen limitation experiments, the location of nitrifying biomass within mixed biofilms (heterotrophic, autotrophic) can be determined. The biofilm model predicts ammonium uptake rate of a trickling filter as a function of the bicarbonate concentration in the water film. (Author's abstract)
W88-04848

THEORETICAL INVESTIGATION OF PARTICLE DEPOSITION IN BIOFILM SYSTEMS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
E. J. Bouwer.
Water Research WATRAG, Vol. 21, No. 12, p 1489-1498, December 1987. 6 fig, 2 tab, 35 ref. NSF Grant ECE-8451060, USGS Grant 14-08-0001-G1284.

Descriptors: *Wastewater treatment, *Biofilms, *Particulate matter, *Mass transfer, Theoretical analysis, Biological wastewater treatment, Deposition, Attachment, Interception, Sedimentation, Mathematical model, Reactor performance.

Experience has shown that the performance of biofilm reactors is strongly influenced by the size distribution of the constituents being biologically oxidized. Processes of diffusion, interception, and sedimentation that affect the transport of solid particles are applied to biofilm systems. Biofilm systems with media of small diameter or long hydraulic residence time (fixed-bed, soil treatment, and fluidized bed) can be effective for removing submicron-sized particles through diffusion and interception. In systems with horizontal biofilm surface area, large particles (>10-50 um) can be removed by sedimentation. The slow mass transfer of particulate biological oxygen demand can cause degradation rates to be much slower than for soluble species. An understanding of particle behavior will facilitate development of better models of biofilm systems. A need is recognized for the development of integrated models that consider simultaneous deposition and detachment of particles. Such models would aid in the design and control of solid/liquid separation facilities to collect the particulates produced as a result of biofilm action. (Author's abstract)
W88-04849

CONVECTIVE DIFFUSION MODEL FOR MASS TRANSFER IN A ROTATING BIOLOGICAL CONTACTOR: DISC SUBMERGENCE <50%,
Bombay Univ. (India).
R. N. Vaidya, and V. G. Pangarkar.
Water Research WATRAG, Vol. 21, No. 12, p 1499-1503, December 1987. 5 fig, 14 ref.

Descriptors: *Wastewater treatment, *Convective diffusion, *Rotating biological contactor, Mathematical models, Biological wastewater treatment, Gas, Solutes.

A convective diffusion model was proposed for transfer of solute gas in a rotating biological contactor (RBC) for the case when the disc submergence is <50%. Volumetric hold-up of the liquid, volumetric rate of absorption (R sub AV), and effect of speed of rotation and physical properties of the liquid on R sub AV are discussed. The model predictions agree with results from others' investigations. The maximum transfer rate occurs when the parameter zeta (= vertical distance from the center of the disc to the pool surface (cm)/ radius of the disc (cm)) = 0.25. (Author's abstract)
W88-04850

EQUILIBRIUM STUDIES DURING THE REMOVAL OF DYESTUFFS FROM AQUEOUS SOLUTIONS USING BAGASSE PITH,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, M. El Geundi, and M. M. Nassar.
Water Research WATRAG, Vol. 21, No. 12, p 1513-1520, December 1987. 12 fig, 4 tab, 13 fig.

Descriptors: *Equilibrium isotherms, *Bagasse pith, *Dyestuffs, *Adsorption capacity, *Wastewater treatment, Particulate matter, Sugar industry, Theoretical analysis, Temperature, Enthalpy.

The adsorption of four dyestuffs, Basic Blue 69 (BB69), Basic Red 22 (BR22), Acid Red 114 (AR114), and Acid Blue 25 (AB25), onto bagasse pith was studied. The effects of pith particle size range and dye solution temperature also were examined. Equilibrium data were analyzed using Langmuir, Freundlich, and Jossens isotherms. High adsorptive capacities were observed for the basic dyes: 158 mg dye/g pith for BB69 and 77 mg dye/g pith for BR22; lower capacities were observed for the acidic dyes: 23 mg dye/g for AR 114 and 22 mg dye/g pith for AB25. Agreement was good between theoretical isotherms and experimental data. All isotherms were shown to be 'favorable' and the effect of pith particle size was significant. The influence of temperature also was studied and enthalpies of adsorption were determined. Bagasse pith is a cheap, abundant waste product from the sugar industry in Egypt. (Author's abstract)
W88-04852

THEORIES FOR ESTIMATION OF THE FRACTION OF DENITRIFIERS IN COMBINED NITRIFYING-DENITRIFYING TREATMENT PLANTS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
M. Henze.
Water Research WATRAG, Vol. 21, No. 12, p 1521-1524, December 1987. 6 fig, 6 ref.

Descriptors: *Activated sludge process, *Nitrification, *Denitrification, *Wastewater treatment, Denitrifer fraction, Biological wastewater treatment, Mathematical Models.

Theories for the estimation of the fraction of denitrifiers in active biomass are proposed. Decay is represented by two concepts: (1) a decay-growth concept, in which organic matter cycles between substrate and biomass, and (2) a traditional decay concept, in which biomass decays without recycling of the substrate. The fraction of denitrifiers is a function of three variables: (1) the potential inlet fraction of denitrifiers (the fraction of the influent material that are denitrifiers after primary growth), (2) the anoxic solids retention time ratio, and (3) the total solids retention time. The potential inlet fraction of denitrifiers is the dominating variable. To maximize the fraction of denitrifiers in the activated sludge, the influent wastewater should be anoxic treated as the first step and the anoxic fraction of the total solids retention time should be as high as possible. (Author's abstract)
W88-04853

EFFECT OF ANAEROBIC CONDITIONS ON ACTIVATED SLUDGE FILAMENTOUS BULKING IN LABORATORY SYSTEMS,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Wanner, K. Kucman, V. Ottova, and P. Grau.
Water Research WATRAG, Vol. 21, No. 12, p 1541-1546, December 1987. 6 fig, 6 tab, 11 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Bulking sludge, *Anaerobic digestion, *Phosphorus removal, *Sphaerotilus, Tertiary treatment, Sulfate reduction, Process control, Bacteria.

The laboratory systems employed consisted of an anaerobic, completely mixed tank followed by an aerobic one. A single oxic, completely mixed tank served as a control unit. Synthetic wastewater incorporating glucose and ethanol as carbon sources was used to support the growth of microorganisms in completely mixed tanks. The growth of some filamentous organisms, for instance, Type 012N and Sphaerotilus natans, was suppressed under anaerobic conditions as a result of lower rates of polyphosphate depolymerization under anaerobic conditions. The positive effect of anaerobiosis may be eliminated if simultaneous dissimilatory sulfate reduction occurs. In this case filamentous bulking caused by such microorganisms as Thiothrix is possible. (Author's abstract)
W88-04856

LONG TERM COMPETITION BETWEEN SULFATE-REDUCING AND METHANE-PRODUCING BACTERIA FOR ACETATE IN ANAEROBIC BIOFILM,
Kurita Water Industries Ltd., Atsugi (Japan).
M. Yoda, M. Kitagawa, and Y. Miyaji.
Water Research WATRAG, Vol. 21, No. 12, p 1547-1556, December 1987. 12 fig, 3 tab, 11 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biofilms, Acetate, Competition, Methane bacteria, Sulfate-reducing bacteria, Long-term studies, Biological wastewater treatment, Fluidized beds.

Long-term competition for acetate between sulfate-reducing bacteria (SRB) and methane-producing bacteria (MPB) was investigated using a laboratory scale anaerobic fluidized bed. When the synthetic wastewater composed of acetate and sulfate was fed at a low organic loading rate, averages of the remaining acetate and sulfate concentrations were 1.7 mg C/l and 78.5 mg/l, respectively. During several months of such acetate-limited operation, the methane production rate and the microbial mass of MPB declined gradually, whereas the amount of reduced sulfate and the microbial mass of SRB increased, apparently indicating that SRB out-compete MPB in the biofilm at lower acetate concentrations. On the other hand, MPB were able to form a biofilm faster than SRB at higher acetate concentrations, presumably due to MPB's higher ability to adhere to carrier surfaces compared to SRB. Kinetic constants for both species in the biofilm were determined and compared with those reported for pure MPB and SRB cultures. Based on the kinetic mechanism of this competition, operational conditions were identified that

would support methanogenesis by suppressing sulfate reduction. (Author's abstract)
W88-04857

MEASUREMENT OF TRACE CONCENTRATIONS OF HYDROGEN IN BIOGAS FROM ANAEROBIC DIGESTERS USING AN EXHALED HYDROGEN MONITOR,
Water Research Centre, Stevenage (England).
L. J. Collins and, and A. R. Paskins.
Water Research WATRAG, Vol. 21, No. 12, p 1567-1572, December 1987. 4 fig, 5 tab, 10 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biogas, Calibration gases, Exhaled Hydrogen Monitor, Hydrogen, Oxygen, Methanogenesis, Sewage sludge.

The cross-sensitivity of the GMI (Gas Measurement Instruments Ltd.) Exhaled Hydrogen Monitor to oxygen in air standards is illustrated and results obtained with alternative standards are reported. Both nitrogen-based standards and standards in a mixture of 60:40 methane:carbon dioxide are suitable. Care is recommended in the acceptance of the accuracy of primary gas standards for hydrogen at low levels. A survey of 20 mesophilic sewage-sludge digesters in England and Wales showed that hydrogen in the biogas ranged from 15 to 199 ppm. (Author's abstract)
W88-04859

1987 BIOCYCLE SURVEY. SLUDGE COMPOSTING ON THE RISE,
N. Goldstein.
Biocycle BCYCDK, Vol. 28, No. 10, p 24-29, November/December 1987.

Descriptors: *Wastewater treatment, *Sludge utilization, *Composting, *Surveys, Wastewater disposal, Economic feasibility, Regulations, Attitudes.

The results of a nationwide survey of sludge composting activities are presented, including information of the 'climate' for the composting industry, capital and operating and maintenance costs, production and marketing, regional variations in activity, and trends and innovations. Sludge composting facilities in the United States are listed state by state, with information on type of plant, operational status, and sludge volume (per dry ton/day). The survey lists 197 sludge composting facilities in the United States, including 107 operational, 15 under construction, 39 in the planning, design, or bid stages, 8 pilot plants, and 28 under consideration. The general climate for sludge composting is healthy. More cities are turning to composting because of the public's positive perception of recycling, the difficulties in siting combustion facilities, and landfill concerns. This trend is especially active in the Northeast. (Rochester-PTT)
W88-04862

ECONOMIC EVALUATION OF WASTE TREATMENT PROJECTS WITH MICROCOMPUTERS,
Maine Univ., Orono. Dept. of Agriculture and Resource Economics.
G. E. Criner and, and M. E. McPartland.
Biocycle BCYCDK, Vol. 28, No. 10, p 39-41, November/December 1987. 4 tab.

Descriptors: *Wastewater treatment, *Microcomputers, *Wastewater facilities, *Economic evaluation, *Computer programs, Revenues, Costs, Computers, Spreadsheet programs.

The application of Lotus 1-2-3 software to wastewater treatment facilities economic feasibility studies is illustrated using as an example a municipal wastewater treatment facility consisting of three lined and aerated lagoons, a building, and associated blowers, lagoon air tubing, pumps, and other equipment. Sensitivity analysis can be performed on the spreadsheet model by holding all factors constant and changing a single factor, such as interest rates, to see what happens to project feasibility. Among the limitations of the type of model used here is that projects are assumed to have similar expected useful lives. Another limitation is the lack of consideration for inflation. The microcomputer spreadsheet program described yields economic information quickly, and may contribute to ending the era of 'back-of-the-envelope' economic analysis. (Rochester-PTT)
W88-04863

BIOMASS RETENTION AND PERFORMANCE OF ANAEROBIC FIXED-FILM REACTORS TREATING ACETIC ACID WASTEWATER,
Kuwait Univ., Safat. Dept. of Civil Engineering.
M. F. Hamoda, and K. J. Kennedy.
Biotechnology and Bioengineering BIBIAU, Vol. 30, No. 2, p 272-281, August 5, 1987. 8 fig, 3 tab, 19 ref.

Descriptors: *Wastewater treatment, *Acetic acid, *Anaerobic digestion, *Biomass retention, *Fixed-film reactors, Kinetics, Organic loading, Digestion, Biological wastewater treatment, Downflow stationary fixed-film reactor, Hydraulic retention time, Chemical oxygen demand.

An acetic-acid-based synthetic wastewater was successfully treated at 35 C in anaerobic downflow fixed-film reactors operated at high organic loading rates and short hydraulic retention times. Substrate removal rates of up to 14 kg COD/cu m day and methane production rates close to 5 cu m/day were achieved at COD removal efficiencies >80%. Substrate removal and methane production rates increased with increased organic loading and decreased hydraulic retention times. A high concentration of biofilm biomass was retained in the reactor. The biofilm accounted for the majority of methanogenic biomass activity. The steady-state biofilm biomass concentration increased with increased organic loading rate and decreased hydraulic retention time to a maximum of 8.3 kg insoluble biofilm volatile solids per cu m at a loading rate of 17 kg COD/cu m day. Using a highly concentrated waste of 20 g COD/liter, a hydraulic retention time of less than 1 day caused unstable performance of the reactor. Biofilm substrate utilization rates of up to 1.6 kg COD/kg insoluble biofilm volatile solids day were achieved. Soluble COD utilization rates in the reactor at various COD concentrations can be described by half-order reaction kinetics. (Cassar-PTT)
W88-04870

OPERATOR'S GUIDE TO ROTIFERS AND WASTEWATER TREATMENT PROCESSES,
M. H. Gerardi.
Public Works PUOAH, Vol. 118, No. 11, p 66-67, November 1987. 1 tab, 5 ref.

Descriptors: *Bioindicators, *Wastewater treatment, *Rotifers, *Wastewater analysis, *Oxidation ponds, *Activated sludge process, *Flocculation, *Biological oxygen demand, Taxonomy, Morphology, Bacteria, Protozoa.

General characteristics and taxonomic classification of rotifers, their roles in oxidation ponds and the activated sludge process, and their role as bioindicators in the activated sludge process are reviewed. Rotifers are ubiquitous invertebrates in aquatic habitats; most are in the 0.2-0.5 mm size range. Some species of rotifers feed on bacteria, detritus, or protozoa, whereas others feed on phytoplankton. Rotifers feed on primary producers in oxidation ponds, aid in removal of bacteria and development of floc in the activated sludge process, and may play a significant role in removal of biological oxygen demand (BOD). Although they are not as durable as ciliates and require a longer time to become established in the treatment process, rotifers can be bioindicators of the conditions in the activated sludge process. They are strict aerobes and usually are found only when the water contains at least a few milligrams/liter of oxygen. In the successional sequence in activated sludge rotifers are the stage beyond stalked ciliates, indicating stabilization of organic wastes. (Rochester-PTT)
W88-04873

OPERATOR'S GUIDE TO FREE-LIVING NEMATODES IN WASTEWATER TREATMENT,
M. H. Gerardi.
Public Works PUOAH, Vol. 118, No. 12, p 47-58, December 1987. 4 ref.

Descriptors: *Nematodes, *Wastewater analysis, *Wastewater treatment, *Trickling filters, *Septic sludge, Soil amendments, Taxonomy, Deoxygenation, Fungi.

General characteristics and taxonomic classification of nematodes, their roles in trickling filters, sewage sludge, and sludge-amended soils, and the factors affecting nematode numbers in wastewaters are reviewed. Microfungi, deoxygenation processes, and low temperatures, as well as changes in wastewater strength and composition, have adverse effects on maximum nematode population development. Food, however, appears to be the major factor controlling nematode numbers; nematode populations increase with higher wastewater strength. As one of several types of macroinvertebrates found in anaerobic wastewater treatment processes, nematodes may occur in relatively large numbers and perform significant roles in the stabilization of organic wastes, particularly in trickling filters. Classification is difficult because numerous species of nematodes may occur at all times within a treatment system and published literature is limited. (Rochester-PTT)
W88-04876

CRITERIA FOR PROJECT PERFORMANCE CERTIFICATION,
Water Pollution Control Federation, Alexandria, VA.
W. M. Cosgrove.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 26-28, January 1988.

Descriptors: *Performance evaluation, *Liability, *Wastewater treatment facilities, Standards, Design standards, Environmental Protection Agency.

The Water Pollution Control Federation's (WPCF) Plant Operations Committee recommendations for compliance with the Federal requirements of accountability for construction grants funds are discussed concerning the following issues: (1) engineer's liability, (2) development of standards, and (3) documentation for EPA certification. The committee decided that WCPF should establish a position on national guidance for the development of performance standard criteria for unit processes, including supporting information to verify certification. Moreover, the WPCF Plant Operations Committee should survey engineering design firms, regulatory agencies, and municipalities to evaluate the following areas of concern: changes in basic design approaches by engineering firms; potential decrease in the use of new or I/A technology; cases where inadequate grantee support resulted in non-certification; changes in the types of guarantees and agreements between design engineers and grantees, equipment manufacturers, and start-up service contractors; compilation of regulatory agency requirements concerning project performance certification; and cases where design errors or omissions resulted in non-certification. (Rochester-PTT)
W88-04880

MINIMIZING LIABILITIES FACING POTWS,
Zorc, Risseto and and Weaver, Washington, DC.
J. M. Zorc, J. C. Hall, and C. L. Risseto.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 29-35, January 1988. 10 ref.

Descriptors: *Industrial wastes, *Liability, *Legal aspects, *Toxicity, *Effluent limitations, Wastewater treatment facilities, Regulations.

The legal ramifications of recent government initiatives that impose demands to control hazardous wastes entering or leaving publicly owned treatment works (POTWs) expose POTWs to certain liability: permit by rule procedures under the Resource Conservation and Recovery Act (RCRA), pretreatment program protections, sludge disposal

rules, and whole effluent toxicity implications. By effective statutory and regulatory coordination, liability for releases of hazardous substances from POTWs can be limited. Statutory coverage of hazardous waste in relation to POTWs, the Clean Water Act, RCRA, sludge disposal under RCRA, Superfund, regulatory loopholes, domestic sewage exemption under RCRA, effluent discharges, exfiltration, liability evaluation, sludge disposal and discharge, whole effluent toxicity, and the midnight dumper problem are reviewed, and a series of recommendations are made for POTWs to follow to limit their legal liability. (Rochester-PTT)
W88-04881

INDUSTRY INITIATES SOURCE PREVENTION,
A. B. Nichols.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 36-44, January 1988. 1 tab.

Descriptors: *Industrial wastes, *Liability, *Legal aspects, *Source Prevention, *Effluent limitations, Waste reduction, Wastewater treatment, Waste management.

As a result of increased environmental compliance costs and the liability associated with waste handling and disposal many industries have adopted waste minimization. An attractive alternative to traditional methods is source prevention, which aims at reducing or eliminating wastes at the point of generation. Source prevention, often called waste reduction, may include reuse/recycling, product reformulation, chemical substitution, process alterations, and 'housekeeping' improvements. Many of these techniques do not require high technology and are inexpensive relative to their potential long-term economic benefits. Often they can be implemented with minimal disruption to the production cycle. Efforts in source prevention made by 3M, Dow Chemical, Borden, and smaller firms are described. The effect of publicly owned treatment works on the adoption of source prevention by their industrial customers is discussed. In an October 1986 report, EPA states that in 25 yr, aggregate waste generation volumes can be reduced by an additional 15-30% by the extension of existing source control techniques. The Office of Technology Assessment has advocated strongly the waste minimization concept. (Rochester-PTT)
W88-04882

PUBLIC OPINION ON WATER REUSE OPTIONS,
California Univ., Berkeley. School of Public Health.
W. H. Bruvold.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 45-49, January 1988. 5 tab.

Descriptors: *Attitudes, *Water reuse, Public Health, Opinion surveys.

The results of seven studies of public opinion on water reuse for a wide variety of purposes show that extent of unfavorable attitude toward reuse of reclaimed water varies directly with the intimacy or degree of human contact of the proposed use of the water. This generalized finding is stable across the available literature. It is proposed that there are two major determinants of public opinion toward specific uses of reclaimed water: (1) degree of human contact and (2) the five factors of health, environment, treatment, distribution, and conservation. Two hypotheses flow from this proposal. First, in surveys of general reuse options, not specifically timed or located, degree of human contact will be the more important determinant of public opinion data. Second, in surveys of reuse options specifically designed for the respondents' home communities, the five factors will be the more important determinants of public opinion. (Rochester-PTT)
W88-04883

TOXICITY REDUCTION AT MUNICIPAL WASTEWATER TREATMENT PLANTS,
Environmental Protection Agency, Cincinnati, OH. Aquatic Biology Section.
T. W. Neiheisel, W. B. Horning, B. M. Austern, D. F. Bishop, and T. L. Reed.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 57-67, January 1988. 1 fig, 8 tab, 35 ref.

Descriptors: *Activated sludge, *Industrial wastewater, *Toxicity, *Secondary wastewater, *Wastewater treatment, Bioassay, Nitrification, Ohio, Cladocera, Fish.

Treatment plants receiving wastewaters from domestic/commercial sources and receiving wastewater from domestic/commercial + industrial sources were evaluated to assess toxicity reduction and determine the importance of source. Seven-day renewal fathead minnow survival and Ceriodaphnia survival and reproduction tests were applied to raw wastewater, unchlorinated, chlorinated, and dechlorinated secondary effluents. All plant influents were toxic and all plant influents showed some residual toxicity. Influent toxicity of the two plant categories was similar. The plant receiving the most toxic influents showed the largest reduction in toxicity and had the least toxic effluents. Toxicity at plants with little industrial wastewater flow was not reduced. Nitrification was reduced at one plant and a high metals concentration occurred at another plant. Toxicity reduction and industrial waste flow did not correlate strongly. Consideration of effluent percentage flow contribution in the receiving waters suggested that potential biological impacts could occur in the reeving waters of the Cuyahoga River at Akron and Great Miami River at Piqua (Ohio). (Author's abstract)
W88-04885

TRICKLING FILTER/SOLIDS CONTACT PERFORMANCE WITH ROCK FILTERS AT HIGH ORGANIC LOADINGS,
Brown and Caldwell, Pleasant Hill, CA.
R. N. Matasci, D. L. Clark, J. A. Heidman, D. S. Parker, and B. Petrik.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 68-76, January 1988. 6 fig, 3 tab, 16 ref. EPA Contract 68-03-1818.

Descriptors: *Wastewater treatment, *Organic loading, *Trickling filters, Suspended solids, Rock media, Wastewater treatment facilities, Performance evaluation.

The performance of the trickling filter/solids contact (TF/SC) process at high organic loadings was studied at the Morro Bay-Cayucos (California) treatment plant. The average secondary effluent total suspended solids (TSS) increased only from 13 mg/l to 15 mg/l when the filter 5-day biological oxygen demand (BOD5) loading was doubled from 480 g/cu m/day to 960 g/cu m/day. The rock trickling filter operated without noticeable odors at the higher loading, although the presence of Beggiatoa indicated that the filter was stressed. When the Morro Bay-Cayucos secondary process operated in the trickling filter mode at the lower filter loadings, average secondary effluent TSS was 28 mg/l. Work at the Coeur d'Alene, Idaho, trickling filter plant showed that average secondary effluent TSS decreased from 25 mg/l to 16 mg/l when an old, shallow secondary clarifier was replaced with a new flocculator-clarifier. (Author's abstract)
W88-04886

PRACTICAL METHODOLOGY FOR PREDICTING CRITICAL OPERATING RANGE OF BIOLOGICAL SYSTEMS TREATING INHIBITORY SUBSTANCES,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy, W. Lowe, A. Rozich, and R. Colvin.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 77-85, January 1988. 8 fig, 6 tab, 15 ref.

Descriptors: *Wastewater treatment, *Specific growth rate, *Bacterial physiology, Growth, Industrial wastes, Bioactivity, Wastewater treatment facilities, Prediction, Mathematical models.

The critical specific growth rate, mu*, corresponding to a critical reactor substrate concentration, S, appears to have practical utility for plant operations and for grading various industrial wastes regarding their potential for causing operational problems. In the current work a test procedure has been modified and extended to substrates other than phenol. The mu* values determined in batch growth studies for 2,4-dinitrophenol and orthochlorophenol predicted the wash-out point for continuous flow reactors that fed these substrates. Change in the numerical values of mu* induced by changes in operation of the continuous flow reactors were reflected in the mu to the 0.5 power values determined from batch studies. (Author's abstract)
W88-04887

ANAEROBIC TREATMENT OF A BIOLOGICALLY INHIBITORY WASTEWATER,
Illinois Univ., Urbana. Dept. of Civil Engineering.
P. Fox, M. T. Suidan, and J. T. Pfeffer.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 86-92, January 1988. 6 fig, 3 tab, 21 ref. DOE Grant DE-AC21-82MC19352.

Descriptors: *Activated carbon, *Anaerobic filters, *Wastewater treatment, *Fluidized bed process, Chemical oxygen demand, Attached film, Methane, Toxicity, Aromatic compounds, Wastewater treatment facilities.

A sequence of unit processes consisting of berl-saddle-packed-bed anaerobic reactor and an expanded-bed, granular activated carbon (GAC) fluidized-bed anaerobic reactor was used for the treatment of a synthetically prepared coal conversion wastewater. The wastewater, with high concentrations of inhibitory compounds, was fed at three different chemical oxygen demand (COD) concentrations: 1,513, 3,027, and 7,567 mg/l. Excellent removal of organic matter combined with high conversion of COD to methane was achieved. Negligible removal of COD was observed in the packed-bed reactor, whereas the expanded-bed GAC reactor removed the majority of the organics in the wastewater. Ortho- and meta-cresol resisted biodegradation and their toxicity to the anaerobic culture in the GAC reactor was overcome by partial replacement of the granular activated carbon medium in that reactor. (Author's abstract)
W88-04888

MATHEMATICAL MODEL OF THE CARBON-LIMITED GROWTH OF FILAMENTOUS AND FLOC-FORMING ORGANISMS IN LOW F/M SLUDGE,
California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
A. M. van Niekerk, D. Jenkins, and M. G. Richards.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 100-106, January 1988. 4 fig, 1 tab, 19 ref.

Descriptors: *Activated sludge, *Wastewater treatment, *Bulking sludge, *Bacteria, Filaments, Carbon, Limiting nutrients, Kinetics, Mathematical models, Prediction.

A mathematical model was developed to predict the behavior of filamentous and floc-forming bacteria under carbon-limited conditions of low food/microorganisms (F/M) activated sludge. Using independently determined kinetic coefficients for the floc-forming bacterium Zoogloea ramigera and the filamentous organism type 021N, the model accurately predicted the effect of the aerobic selectors on bulking sludge in such systems. (Author's abstract)
W88-04890

ATP AS A MEASURE OF ANAEROBIC SLUDGE DIGESTER ACTIVITY,
California Univ., Los Angeles. Dept. of Civil Engineering.
Y. C. Chung and, and J. B. Neethling.
Journal - Water Pollution Control Federation

JWPFA5, Vol. 60, No. 1, p 107-112, January 1988. 3 fig, 4 tab, 20 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Bioactivity, *Adenosine triphosphate, Wastewater treatment, Hydrogen ion concentration, Luciferase, Luciferin, Sludge, Bacterial physiology.

A simple luciferase/luciferin light measurement technique produced consistent results measuring the adenosine triphosphate (ATP) content of anaerobic sludges. The ATP content of a laboratory-scale anaerobic sludge product correlated well with other indirect activity measurements, including gas production rate and pH changes. ATP reflected changes in the digester dynamics, responded rapidly to pulse feeding of the digester, indicated inhibition of the anaerobic bacteria, and reflected changes in the activity at various sludge ages. The ATP content of the anaerobic sludge responded rapidly to changes in the digester operation, which may result from increased non-growth-associated biochemical activity. (Author's abstract)
W88-04891

METAL CHEMISTRY DIFFERENCES BETWEEN DIGESTED AND UNDIGESTED SLUDGES,
Delaware Univ., Newark. Coll. of Marine Studies.
R. J. Gibbs and, and M. Angelidis.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 113-118, January 1988. 2 fig, 2 tab, 24 ref. NOAA Ocean Assessment Division Grant NA-82-RAD009.

Descriptors: *Sludge, *Metals, *Secondary treatment, *Anaerobic digestion, *Organic carbon, *Wastewater treatment, Bacterial physiology, Chemical reactions.

Metal partitioning differences were found during a study of digested and undigested sludge chemical phases. The anaerobic digested sludges contained relatively more metals in the oxidizable phase but, in general, the chemical partitioning was similar for both the aerobic and anaerobic sludges. Conversely, the undigested sludge, although containing 1.5x more organic carbon than the digested sludge, did not contain a high metal concentration in the oxidizable phase as did the digested sludge. The microbial activity and physicochemical changes that occur during digestion were considered to be the reasons for this difference in metal chemistry. (Author's abstract)
W88-04892

TREATMENT SCHEME FOR CONTROLLING THE MIGRATION OF RADIUM FROM A TAILINGS IMPOUNDMENT,
Battelle Pacific Northwest Labs., Richland, WA.
B. E. Opitz.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 499-509, 2 fig, 5 tab, 11 ref. NRC Contract No. DE-AC06-76RLO 1830, NRC FIN B2370.

Descriptors: *Wastewater treatment, *Water pollution prevention, *Mine wastes, *Uranium, *Radium, Groundwater pollution, Radioactivity, Acidic waters, Lime, Barium chloride, Leaching.

Under sponsorship of the Nuclear Regulatory Commission's Uranium Research and Recovery Program, Pacific Northwest Laboratory (PNL) has investigated the use of various neutralizing reagents and techniques to attenuate the movement of contaminants associated with acidic uranium mill tailings. The objective of this study was to identify contaminants that are not effectively attenuated by common neutralization methods and to develop alternative control measures. Of those contaminants associated with uranium mill tailings that were identified as not being effectively immobilized by tailings neutralization, radium imposes an important environmental concern in terms of potential groundwater contamination. Control or attenuation of radium is of special concern primarily due to its radiological health implications. For that reason, the EPA has implemented strict guidelines governing the maximum allowable concentration in drinking waters. Current EPA guidelines call for total Ra activities not to exceed 5 pCi/l. Due to the high activity of soluble Ra in the acidic uranium mill tailings environment (several hundred to several thousand pCi/l), specific ion removal procedures were investigated for use in attentuating Ra in order to prevent future groundwater contamination. Results of these investigations led to the development of a tailings additive comprised of a mixture of hydrated lime and barium chloride, which, when added to acidic tailings, can reduce the amount of leachable radium escaping a designated tailings impoundment. In laboratory verification tests, this Ra-specific tailings treatment reduced the effluent solution activity of Ra by three orders of magnitude, from >3500 pCi/l to 1.7 pCi/l, in comparison with untreated acidic tailings. (See also W88-04980) (Author's abstract)
W88-05009

INACTIVATION OF ANIMAL VIRUSES DURING SEWAGE SLUDGE TREATMENT,
Zurich Univ. (Switzerland). Inst. of Virology.
S. K. Spillmann, F. Traub, M. Schwyzer, and R. Wyler.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 9, p 2077-2081, September 1987. 3 fig, 2 tab, 24 ref. Swiss National Foundation for Scientific Research Grant 4.621.0.85.07.

Descriptors: *Wastewater treatment, *Sludge digestion, *Viruses, *Digestion, Rotaviruses, Coxsackieviruses, Parvoviruses, Aerobic digestion, Anaerobic digestion, Biological indicators, Sludge disposal.

The inactivation of a human rotavirus, a coxsackievirus B5, and a bovine parvovirus was monitored during sludge treatment processes. The most favorable treatment was determined to be thermal treatment at 60 C to inactivate thermolabile viruses (e.g., rotavirus) followed by anaerobic mesophilic digestion to eliminate thermostable virus (e.g., parvovirus). Conventional anaerobic mesophilic digestion at 35-36 C produced minor inactivation of the three viruses. The k' values (in log unit/day) were as follows: rotavirus, 0.314; coxsackievirus, 0.475; parvovirus, 0.944. Anaerobic thermophilic digestion at 54-56 C rapidly inactivated viruses; k' values (in log unit/day) were rotavirus, >8.5; coxsackievirus B5, >0.93. Aerobic thermophilic fermentation of 60-61 C rapidly inactivated viruses; k' values (in log unit/day) were rotavirus, 0.75; coxsackievirus B5, >1.67. However, reduction of parvovirus activity was not as efficient with anaerobic thermophilic digestion (0.213 log unit/hour) and aerobic thermophilic fermentation (0.353 log unit/hour). Pasteurization at 70 C for 30 min produced a k' value of 0.72 log unit/30 min. Temperature was the predominant inactivating agent in processes operating at >54 C. An appropriate choice of biological indicators for measuring the effectiveness of the digestion treatment is parvovirus for thermal inactivation and rotavirus for chemical factors such as ammonia and detergents. (Cassar-PTT)
W88-05059

EFFECTIVENESS OF TERTIARY WASTEWATER TREATMENT IN RIVER-BASIN SCALE,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
M. Lowgren, and G. Karlsson.
Journal of Environmental Management JEVMAW, Vol. 25, No. 1, p 13-26, July 1987. 8 fig, 2 tab, 37 ref.

Descriptors: *Wastewater treatment, *Tertiary wastewater treatment, *Cost analysis, *River basins, *Phosphorus removal, Svarta River, Sweden, Biological wastewater treatment, Secondary wastewater treatment, Water quality standards, Chemical precipitation, Urban areas.

In 1969 Sweden passed an Environmental Protection Act aimed at preventing environmental problems caused by point-source emissions into air and water. A study was conducted to analyze investment costs of abatement and to evaluate the effects that different types of wastewater treatment, taken into practice from 1966 to 1984, have had on reducing point-source discharges of phosphorus from urban areas and industries within the Svarta River Basin in southern Sweden. Chemical precipitation (tertiary treatment) of wastewater was rapidly adopted at a cost of 80 million SEK; in 1970, 98% of the urban population had biological (secondary) or mechanical (primary) treatment of sewage. Ten years later, almost 100% were served by tertiary treatment plants. The estimated load of total phosphorus from point-source discharges decreased from 50,000 kg annually in 1970 to 8,600 kg by 1980. For economic reasons, the shift in technology called for larger, more technically efficient units. However, there was no sharp decline in the level of phosphorus transports in the Svarta River after the introduction of chemical precipitation. The trend had already started to decline approximately five years earlier, and the transport pattern did not coincide with the changes of point-source discharges. Therefore, the effectiveness of point-source removal as a means of controlling eutrophication is questioned. It is concluded that there is a need for objectives related to water quality standards rather than to emission standards. (Author's abstract)
W88-05063

5E. Ultimate Disposal Of Wastes

STATISTICAL MODELS FOR THE ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN WASTE DISPOSAL SITES,
Illinois State Psychiatric Inst., Chicago.
For primary bibliographic entry see Field 5B.
W88-04491

SLUDGE BRINGS LIFE TO MICROBIAL COMMUNITIES,
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
W. E. Sopper, and E. M. Seaker.
BioCycle BCYCDK, Vol. 28, No. 9, p 40-42, 46-47, October 1987. 1 fig, 8 tab, 24 ref. EPA Grant No. R811248-01.

Descriptors: *Sludge disposal, *Microorganisms, *Waste disposal, *Land reclamation, Ecosystems, Mines, Vegetation, Sludge amendment, Microbiological studies, Soil environment.

The long-term goal of mine land reclamation is the establishment of a stable ecosystem. This includes, not only the establishment of a self-sustaining vegetative cover, but also the development of a normal functioning microbial community. Although minespoils can eventually recover normal soil characteristics through intensive reclamation and management techniques, annual fertilizer additions are usually required for several years. Without the annual maintenance, vegetative cover often deteriorates because microbial development is slow and nutrient cycling never becomes fully operative. The use of sludge as a spoil amendment eliminated the initial lag period which characterizes conventionally reclaimed sites, during which plant growth and microbial activity are at a low level, each one sufficient for maximum functioning of the other. Sludge amendments quickly increased the number and activity of microorganisms, resulting in increased availability of plant nutrients, and development of a soil environment conducive to continued plant growth. Development of an indigenous microbial community was achieved on all sites, which will provide long-term site stability through biogeochemical cycling of energy and nutrients. Recovery of normal soil populations and processes in the surface 5 cm appeared to occur within two years, and does not show a tendency to deteriorate. Microbial populations, respiration, and decomposition were enhanced compared to the control area where chemical fertilizer was used. (Lantz-PTT)
W88-04511

COMPLYING WITH LAND APPLICATION REGULATIONS,
Bio Gro Systems, Inc., Annapolis, MD.
J. B. Forste.
BioCycle BCYCDK, Vol. 28, No. 9, p 49-53, October 1987. 7 fig, 1 tab, 7 ref.

Descriptors: *Land disposal, *Waste disposal, *Regulations, *Sludge disposal, Permits, Municipal wastes, State jurisdiction, Federal jurisdiction, Public opinion.

Although permits are often required for utilization of non-municipal sludges, current regulatory programs are generally designed for the land application of municipal sludge. At the federal level, municipal sludges are regulated under the Water Pollution Control Act of 1972, the Clean Water Act, RCRA, and the 1987 Water Quality Act. Federal regulations are usually administered by various state programs. While the contents of permit applications vary from state to state, most will contain: a request for sludge from the farmer and landowner; laboratory testing of the sludge and soil; information about crops to be grown; maps which serve to locate each site; and an operation plan which describes the methods by which sludge will be applied in the field. Field operations vary from one project to another and from one type of sludge to another, but all field operations have certain elements in common. Transport vehicles bring sludge to the field for injection or surface application, either as a liquid or cake material. To conform to the permit limitations, applicator equipment is calibrated to apply the desired amount of sludge per acre. Further, strict records must be maintained for complete compliance with permits. One of the most sensitive and difficult areas to address in complying with sludge programs regulations is the public perception of a land application program. Public relations and risk perception are often a focal point for regulatory decisions at the state and local levels. As sludge programs become more common and more visible, public interest in such programs is intensifying and public meetings, field days and media coverage all serve to provide the educational information necessary to operate a land application program. (Lantz-PTT)
W88-04512

HEALTH FEARS CROP IRRIGATION PROMISE,
For primary bibliographic entry see Field 5C.
W88-04516

COMPOSTING SLUDGE WITH REEDS,
Tohoku Univ., Sendai (Japan). Biological Inst.
For primary bibliographic entry see Field 5D.
W88-04524

FUTURE USE OF SLUDGE ENTRENCHMENT SITES,
Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab.
L. J. Sikora, and M. E. Radecke.
BioCycle BCYCDK, Vol. 28, No. 8, p 48-53, September 1987. 8 tab, 13 ref.

Descriptors: *Sludge disposal, *Disposal sites, *Entrenchment, *Agriculture, *Waste disposal, Heavy metals, Copper, Cadmium, Lead, Crops, Crop yield, Plant growth, Monitoring.

Sewage sludge entrenchment was the primary method of sludge disposal for municipalities in the Washington, D.C. area from 1974 through 1980. The Blue Plains wastewater treatment plant sewage sludge is classified as a domestic sludge in that it receives very little industrial input. It is characterized as having a low heavy metal content and a high pH, a result of lime addition during the dewatering process. The objective of this monitoring study was to determine the future agricultural use of sewage sludge entrenchment sites. The entrenched sludge is considered stabilized after five years. Inasmuch as the sludge was buried below the plow layer at rates 10 times higher than that recommended for surface applications (5-40 dry mt/ha), there was a concern over the quality of food chain crops grown on these entrenchment sites. The total amount of zinc (Zn), copper (Cu), cadmium (Cd), and lead (Pb) buried at this application rate was approximately 560, 240, 5.75, and 250 kg/ha, respectively. The metal concentrations recorded in this three-year study were well below the maximum tolerable levels for animal feed recommended by the National Academy of Sciences. Thus, the Maryland Department of Health and Mental Hygiene allowed the crops from these sites to enter the food chain, with their only restriction being that they were not to be consumed directly by humans. Poor surface soil conditions resulting from the trenching operations had an adverse effect on plant growth and yields. Surface soils amended with unscreened sewage sludge compost exhibited better plant growth and survival but also increased the total heavy metal application to the site. The future use of sewage sludge entrenchment sites for agricultural production should include farm management practices to restore organic matter levels and fertility to the surface soils. (Lantz-PTT)
W88-04525

COMPARISON OF GROUND WATER MONITORING DATA FROM CERCLA AND RCRA SITES,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV. Environmental Chemistry Dept.
For primary bibliographic entry see Field 7C.
W88-04551

WATER-HYACINTH (EICHHORNIA CRASSIPES) IN RUMINANT NUTRITION,
Sao Paulo Univ., Piracicaba (Brazil). Secao de Ciencias Animais.
For primary bibliographic entry see Field 3F.
W88-04624

TEST PROGRAM IMPROVES SEWER REHABILITATION,
RJN Environmental Associates, Inc., Wheaton, IL.
For primary bibliographic entry see Field 5D.
W88-04664

POTENTIAL FOR MIGRATION OF HAZARDOUS WOOD-TREATING CHEMICALS DURING LAND TREATMENT OPERATIONS,
Mississippi State Univ., Mississippi State. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W88-04754

ORGANIC COMPOUND EFFECTS ON SWELLING AND FLOCCULATION OF UPTON-MONTMORILLONITE,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W88-04759

1987 BIOCYCLE SURVEY. SLUDGE COMPOSTING ON THE RISE,
For primary bibliographic entry see Field 5D.
W88-04862

INTEGRATED RESOURCE RECOVERY SYSTEM,
Cal Recovery Systems, Inc., Richmond, CA.
L. F. Diaz, G. M. Savage, and C. G. Golueke.
Biocycle BCYCDK, Vol. 28, No. 10, p 47-52, November/December 1987. 4 tab, 11 ref.

Descriptors: *Waste recovery, *Recycling, *Solid waste disposal, Modular design, Systems analysis, Water pollution, Waste disposal, Particulate matter, Dusts.

An integrated resource recovery system of modular construction was designed to operate on the generalized waste stream for the United States; it would have to be adjusted to local waste makeup in an actual implementation. The basic module is the dry processing plant, which provides the intermediate products for further end-product enhancement. In the dry plant, ferrous metals, light and heavy organic fractions, and a clean light fraction (predominantly paper and plastic) are recovered. The screened light fraction (with glass and nonferrous metals removed) can be used as a fuel or in a wastepaper pulp mill. Organic fractions are composted, with or without the addition of sewage sludge. Among the potential environmental problems of such a plant are generation of wastewater and particulate emissions; the plant is within a building, so noise pollution is not a problem. Cocomposting, mixing refuse, yard waste and sludge cake, wet processing, and wastewater treatment problems are discussed in detail. (Rochester-PTT)
W88-04864

ENVIRONMENTAL CONSIDERATIONS FOR OCEAN OUTFALLS AND LAND-BASED TREATMENT PLANTS,
Memorial Univ. of Newfoundland, St. John's. Faculty of Engineering and Applied Science.
J. H. Allen and, and J. J. Sharp.
Canadian Journal of Civil Engineering CJCEB, Vol. 14, No. 3, p 363-371, June 1987. 4 fig, 8 tab, 16 ref.

Descriptors: *Ocean dumping, *Outfall sewers, *Domestic wastes, *Wastewater disposal, Public policy, Canada, Wastewater treatment facilities, Regulations.

The environmental problems and benefits of discharging domestic wastes through a submerged ocean outfall after minimal on-land treatment were compared with those of a totally land-based treatment plant. Water quality standards obtained by both systems are enumerated, and other environmental problems are taken into account. Consideration is given to biological, chemical, and bacterial effects; aspects of aesthetics and health also are discussed. Regulations governing discharges in Canada, the United States, and Europe are discussed in light of the evidence presented. It is concluded that in most circumstances the ocean outfall approach will be preferable, and full treatment should never be chosen unless detailed economic and environmental comparisons have been made. Canadian federal regulations, which prohibit discharge of partially treated sewage wastes to waters under federal jurisdiction, are regarded as having little technical justification. (Author's abstract)
W88-04867

COMPLEX STORM SEWER PROJECT AIDED BY INNOVATIVE PIPE DESIGN,
Middletown, OH.
For primary bibliographic entry see Field 4A.
W88-04871

MARINE DISPOSAL OF STABILIZED METAL PROCESSING WASTE,
Corps of Engineers, New York. New York District.
A. F. Lechich and, and F. J. Roethel.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 93-99, January 1988. 5 fig, 6 tab, 15 ref.

Descriptors: *Marine disposal, *Waste disposal, *Industrial wastes, *Fly ash composite, Pozzolans, Artificial reefs, Chemical reactions, Seawater.

A method for the disposal of a potentially hazardous waste material was studied. The method uses fly ash and other additives to stabilize neutralized waste materials generated during titanium metal processing. The pozzolanic properties of the material allow for safe disposal in the ocean as artificial reefs. An optimum mixture in terms of compressive strength was developed and test blocks were physically and chemically tested. Permeability and compressive strength were measured and leachate studied. The blocks maintained structural integrity in seawater, only very small amounts of inorganic constituents were released from stabilized waste blocks. (Author's abstract)

W88-04889

DOE HIGH-LEVEL NUCLEAR WASTE REPOSITORY PROGRAM -- AQUIFER IMPACTS,
Texas Office of the Governor, Austin. Nuclear Waste Programs Office.
S. Frishman.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 405-411.

Descriptors: *Radioactive waste disposal, *Water quality, *Groundwater management, *Groundwater pollution, *Aquifers, Groundwater irrigation, Environmental impact statement, Environmental effects, Water pollution effects, Radioactive wastes, Regulations, State jurisdiction, Federal jurisdiction, Underground waste disposal, High Plains, Texas.

Two of the nine sites in the nation currently being studied by the U.S. Department of Energy (DOE) as potential high-level nuclear waste repositories lie in the southern High Plains of the Texas Panhandle. The potential host rocks are the bedded salts of Permian age of the Palo Duro Basin which are overlain by the Triassic Dockum group, containing some productive water-bearing units, and the Ogallala Formation, which is the primary water source for irrigation of this productive agricultural area. If one of the Texas sites is selected for detailed site characterization an exploratory shaft will be constructed for at-depth studies of the target salt beds between approximately 2,400 and 2,600 feet below the land surface. Among the issues of concern in this phase of investigation are: protection of water quality in the aquifers over the salt horizon; water consumption during shaft construction and site characterization; water and land rights acquisition for site characterization; aboveground storage and disposal of mined salt; and site and shaft construction, operation, decommissioning and closure. Many of the general issues are the same as above for the site and area if the site is selected for disposal of high-level nuclear waste, but with a major increase of scale. In addition, potential short- and long-term contamination of surface and subsurface waters and sediments by radioactive materials adds a further dimension of concern for the users of the aquifers and agricultural lands of the Texas Panhandle. State interests have been and continue to be concerned with the apparent low level of DOE's sensitivity to local issues which relate to the aquifers as sole sources of potable water and crop irrigation water. Texas is continuing to attempt to address this problem through legislation and involvement in federal rulemaking processes. (See also W88-04894) (Author's abstract)
W88-04920

ASSESSING THE POTENTIAL WATER QUALITY HAZARDS CAUSED BY DISPOSAL OF RADIUM-CONTAINING WASTE SOLIDS BY SOIL BLENDING,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
G. F. Lee, and R. A. Jones.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 511-520, 10 ref.

Descriptors: *Water quality, *Waste disposal, *Radium, *Water pollution sources, *Soil blending, Leaching, Path of pollutants, Drinking water, Barium, Sulfates, Hydrogen ion concentration, Monitoring, Clay, Sorption, Land disposal.Groundwater quality, Fate of pollutants.

The disposal of 226-Ra contaminated waste solids by soil blending appears to have limited utility. The potential for long-term, slow leaching of 226-Ra from the blended soils, coupled with the very low drinking water standard for 226-Ra and the increased cancer risk associated with that standard, mandates that great caution be exercised in utilizing such an approach. Radium-226 has been found to be leachable from some natural strata, as well as from uranium mill tailings and similar materials. The rate and extent of leaching depends on a wide variety of factors, with liquid to solid ratio, and barium and sulfate content of the water and matrix being the most important. The pH, organic content, and clay type and content may also be important. The leached 226-Ra can be readily sorbed on and immobilized by clays and possibly other solids. Site-specific, long-term leaching and sorption studies should be done to evaluate the potential for surface and groundwater contamination at the proposed disposal site for the blended soil. Any soil blending system should be accompanied by a long-term monitoring of groundwaters and surface water, vegetation, and organisms to ensure that potentially significant environmental contamination with 226-Ra or other contaminants from the site does not occur. As part of establishing the soil blending system, funds should be provided to ensure that monitoring, site maintenance, and remedial measures will be undertaken as long as there is any 226-Ra present at the site in sufficient amounts to potentially cause environmental contamination. (See also W88-04980) (Lantz-PTT)
W88-05010

OCCURRENCE AND TREATMENT OF URANIUM IN POINT OF USE SYSTEMS IN COLORADO,
EDC, Inc., Lakewood, CO.
For primary bibliographic entry see Field 5F.
W88-05012

5F. Water Treatment and Quality Alteration

MONITORING WATER SUPPLY AND DISTRIBUTION,
WRC Engineering, Swindon (England).
G. Devine.
Water Resources Journal, No. 152, p 54-56, March 1987. 2 fig.

Descriptors: *Water supply, *Water distribution, *Costs, Economic aspects, Pumping, Simulation analysis, Water demand, Competing use, Monitoring, Leakage.

The water distribution network represents the largest capital investment of any component part of a water supply system. Yet until recently, it has received little active monitoring or control. The need to minimize costs in terms of energy, leakage, manpower, resource development has focused attention on distribution systems. New technology makes it possible to improve the cost-effective use of available assets with the aim of reducing operating costs while maintaining or improving standards of service. Modern technology-based systems provide management information which helps to enhance day-to-day water distribution operations as well as other functions such as planning, maintenance, resource allocation, expenditure control and customer relations. A number of the available techniques (regular scheduling of pumps; simulation of supply and distribution network operations; short term demand prediction; leakage control; and pressure control) and some of the advances made in leakage control methods are outlined. Future developments in the broad field of water distribution management are also considered. (Lantz-PTT)
W88-04517

LIVING WITH LEAKS; CRACKS AND SEEPAGE LIMIT BANGKOK'S SUPPLY,
T. Sharp.
Water Resources Journal, No. 152, p 57-58, March 1987. 1 fig.

Descriptors: *Leakage, *Bangkok, *Thailand, *Cracks, *Seepage, *Water conveyance, Hydraulic structures, Water supply, Water transport, Tunnel failure, Tunnels.

For the next three years, Bangkok's Metropolitan Waterworks Authority (MWA) will be forced to live with an unpleasant fact: its stage I transmission tunnel is substandard. Basic problems include circumferential cracking, holes and seepage through the concrete walls of the tunnel. No really effective remedial action can be taken until the first part of Stage II (now called Project 3) is complete in 1989. Although many charges and counter-charges have been made, the basic facts are as follows: First, concrete transmission tunnels are known to be prone to cracking. Second, they are cheaper than more flexible steel tunnels. Third, at the time when Stage I was bid back in the mid 1970s as two separate projects (now called Project 1 and 2) the estimated cost of the whole scheme had escalated by several hundred per cent. Fourth, there was very strong pressure to accept low cost bids, and in any case Thai public sector organizations are generally required to accept the lowest bid. The net result has been that the Stage I tunnel has so far been closed three times for repairs. Most of the cracks are located over a 2 km stretch beginning about 2.5 km south of the Bang Khen water treatment plant. There is another small group of cracks near km 7 and a third, rather more worrying, damaged area much farther downstream towards the spur that serves Thonburi on the west bank of the Chao Phya river. Even where the tunnel is undamaged, there is loss of water through the concrete walls of the tunnel by seepage. Such seepage could cause subsidence in the soils surrounding the tunnel which might then suffer minor structural failure. However, the MWA will have to wait until the Project 3 loop is finished before it can shut down the affected sections and find out exactly what has happened. Then, long after the opening of the tunnel, the MWA will finally be able to operate its transmission tunnel at the design pressure. (Lantz-PTT)
W88-04518

VIET NAM PLANS WATER SUPPLY SCHEMES FOR 65 MILLION,
T. Sharp.
Water Resources Journal, No. 151, p 63-64, December 1986. 4 tab.

Descriptors: *Viet Nam, *Water supply development, *Water conveyance, Urban areas, Rural areas, Financial aspects, Water demand, Water supply, Potential water supply.

Viet Nam intends to harness some 3.8 million cu m/day of additional water supplies to serve 64.7 million people by the year 2000. Urban systems would be expanded by an additional 1.3 million cu m/day to reach a total of 15.4 million people in 2000. The entire expected urban population would thus receive 100 l/person/day (lpd) with the balance absorbed by industry and public usage. Rural water supply, currently consisting mainly of shallow wells and village ponds supplying 12.3 million people, would be expanded by 2.5 million cu m/day to reach 49.3 million people, or 80% of the expected rural population in 2000. Supply level would be 55 lpd. Rural water supply targets may in practice be considerably less clearly defined than the figures would indicate, and it was thus suggested that rural activities by taken five years at a time with feed-back from the previous period being used to adapt future plans. Viet Nam's current urban water supply infrastructure consists of 85 separate water supply systems with a combined design capacity of 1.4 million cu m/day. Many of the systems are old and run down, however, so that actual production is about 1 million cu m/day; an estimated 20% of this is lost. The volumes of additional urban water to be supplied within each five year period are given. Priority will be given to the four key cities (including Hanoi and Ho Chi Minh City) up to 1990. Provincial capitals will receive priority between 1990-95. During the third period, 640,000 cu m/day new and expanded capacity will be installed in district towns. The main source will be surface water. The financial aspects of the program do not yet appear to be very clear. Fund sources are listed as: state allocations 30%, people's contribution 30%, and foreign loans and assistance 40%. The plan suggests that full cost recovery would not be attempted: nominal water charges will be made to users with their own house connections, and no charge to standpipe users. Householders would have to pay the cost of linking their house to the delivery system. (Lantz-PTT)
W88-04554

ASSESSMENT OF WATER QUALITY IN THE INADI WARD, VULINDLELA DISTRICT, KWAZULU,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Crop Science.
P. G. Alcock, and E. Verster.
Water SA, Vol. 13, No. 4, p 215-224, August 1986. 1 fig, 10 tab, 33 ref.

Descriptors: *Water quality, *KwaZulu, *South Africa, *Drinking water, *Pollutant identification, Water supply, Chemical analysis, Hydrogen ion concentration, Dissolved solids, Electrical conductivity, Microbiological studies, Surface waters, Groundwater quality, Rain, Seasonal variation, Water quality control.

An assessment of rain water, groundwater and surface sources of water, in terms of selected bacteriological and chemical variates (pH, total dissolved solids, electrical conductivity), was conducted in the peri-urban/rural Inadi ward, Vulindlela district of KwaZulu, South Africa. The survey showed that no problems are likely to be encountered in terms of chemical potable standards, although for bacteriological requirements, untreated surface water sources were not acceptable. Unprotected and protected springs were found to yield a markedly better bacteriological grade of water by comparison with surface sources, while roof runoff and a borehole provided the best bacteriological water quality. The data also showed that spring protection results in water of a significantly higher bacteriological grade by comparison with unprotected springs. Protection is accordingly, if correctly applied, an accepted treatment for the upgrading of spring-water supplies. There was some evidence that rain water stored in zinc-lined containers, whether open or enclosed, was of an improved bacteriological quality in terms of non-zinc rain-water vessels. Protected springs, roof runoff and boreholes, therefore, could serve as intermediate sources of potable water in the ward, until formal treated reticulated supplies are established. (Author's abstract)
W88-04565

ACCURACY AND PRECISION ENHANCEMENT FOR TOTAL RESIDUAL CHLORINE BACK TITRATION,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
For primary bibliographic entry see Field 5G.
W88-04590

CONTAMINATED DRINKING WATER AS A POTENTIAL CAUSE OF CANCER IN HUMANS,
International Agency for Research on Cancer, Lyon (France).
For primary bibliographic entry see Field 5C.
W88-04660

EVALUATION OF THE DISINFECTION EFFECTIVENESS OF AN OZONE TREATMENT DEVICE FOR INDIVIDUAL WATER SUPPLY,
East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
A. F. Iglar, and B. E. Okome.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 79-82, 4 tab, 4 ref.

Descriptors: *Water treatment, *Ozonation, *Disinfection, *Drinking water, *Water quality, Ozone, Water supply, Coliforms, Microbiological studies, Water temperature, Hydrogen ion concentration.

Ozone does not increase the organic salt content of the water, does not impart any taste or color, and is a powerful disinfectant. Ozone is not in common use, chiefly because it produces little or no residual in the distribution system. However, it has been noted that ozone treatment is potentially adaptable to individual water supplies. Its advantages in this application include simplicity, effectiveness over a wide range of pH, and a minimum need for consumable supplies, such as chlorine. This study attempts to determine the effectiveness of a particular compact ozonator, the 'Sojo Model 243-INGL,' based on levels of microorganisms prior to and after treatment. Tests were performed for heterotrophic plate count coliforms, and fecal coliforms. The results for heterotrophic plate count showed reductions of 54% to 100%. Although this indicates that the ozone had value, it is not a clear indicator of the effectiveness of ozone as a disinfectant. Analysis of variance performed on the results for heterotrophic plate count showed that there were some significant differences among the mean levels in the ozone treated water ($p=0.05$). The range of pH from 7.0 to 8.4 observed in this study compares with a range of 5.6 to 9.8 given previously for bacteriocidal activity from ozone. The few instances of elevated turbidity levels may have been the result of entrance of drainage from the surface. The ozonator used provided no indication of the ozone dose and no way to vary the dose in a convenient manner. However, ozone residual levels in the individual samples ranged from 0.19 to 0.58 mg/l. Previous studies had listed residual ozone levels of 0.1 to 0.4 mg/l as required for disinfection, depending on the microorganisms, and based on a contact period of 10 seconds to 5 minutes. Therefore, the ozone residuals may have been satisfactory. (Lantz-PTT)
W88-04680

EVALUATION OF THE FEASIBILITY OF A MULTI-PURPOSE SOLAR ROOF STILL IN THE VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
For primary bibliographic entry see Field 3A.
W88-04706

METHOD FOR OIL RECOVERY FROM RESERVOIR ROCK FORMATIONS,
For primary bibliographic entry see Field 3C.
W88-04727

POLYMERFLOOD PROCESS,
Phillips Petroleum Co., Bartlesville, OK.
A. Moradi-Araghi, and J. E. Shaw.
U. S. Patent No. 4,586,568; May 6, 1986, 6 p. Official Gazette of the United States Patent Office, Vol 1066, No 1, p 148, May 6, 1986.

Descriptors: *Patents, *Oil recovery, *Oil reservoirs, *Polymers, *Flooding, *Injection, Viscosity, Temperature effects, Salinity, Cations, Additives, Acids.

Low molecular weight polymers of alpha, beta-unsaturated mono- and dicarboxylic acids are used to stabilize polymer solution viscosity of polymeric viscosifiers during a polymerflood process in subterranean petroleum bearing deposits under high temperatures, salinity, and concentrations of hardness ions. The suppresion of the loss of solution viscosity stabilizies the solution viscosifying capacity of the high molecular weight polymeric viscosifier, particularly under such conditions as temperatures above 170 F and the presence of greater than 500ppm of hardness cations. (Cremmins-AEPCO)
W88-04794

METHOD OF OIL RECOVERY,
W. M. Harrison.
U. S. Patent No. 4,679,627; July 14, 1987, 9 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1080, No 2, p 704, July 14, 1987.

Descriptors: *Patents, *Oil recovery, *Oil reservoirs, *Injection, Hydrocarbons, Solvents, Pressure distribution, Sodium, Detergents.

Petroleum fluids are recovered from an underground reservoir after the production zone is watered out. A water insoluble gas, which may or may not be oil soluble, is injected into the reservoir. If the initial gas is not soluble in oil, a second gas is added. This gas may be soluble in oil or water, or both. The gas and water contact becomes gas, oil, and water so that the water leg no longer acts as a barrier to water soluble gases. The soluble gases dissolve into their solute reservoir fluids. The formation is then treated with one or more compression waves or soundwaves of from one shock wave to 50,000 cycles per second. The dissolved gases exit the solution, forcing the entrapped fluids of the reservoir to exit the capillaries and be produced. The released gases are redissolved into the freshly exposed oil zone and the cycle is repeated until most of the oil is produced. (Cremmins-AEPCO)
W88-04795

MISCIBLE OIL RECOVERY PROCESS,
Mobil Oil Corp., New York.
K. J. Hartman, and W. R. Shu.
U. S. Patent No. 4,678,036; July 7, 1987, 7 p, 5 tab. Official Gazette of the United States Patent Office, Vol 1080, No 1, p 135, July 7, 1987.

Descriptors: *Patents, *Oil recovery, *Oil reservoirs, *Injection, Additives, Solvents, Carbon dioxide, Oil wells, Flooding, Solubility, Hydrocarbons.

Oil is recovered from subterranean, oil-bearing reservoirs using a miscible displacement fluid such as carbon dioxide and an additive such as butane. The solvent initially injected into the formation contains a large amount of the solubility additive, which is progressively reduced as the flooding proceeds and more solvent is injected. The solubility additive remains in the reservoir together with residual oil not displaced by the initial solvent and acts to improve the solubility of the residual oil in further portions of solvents, which are injected with a smaller proportion of additive. The mixture of solvent and additive is preferentially injected in slugs with intervening water slugs to improve the sweep of the process. The bank of solvent may be driven through the reservoir by continuous water injection until the process is no longer economically feasible. (Cremmins-AEPCO)
W88-04796

POLYMERIZABLE SURFACTANTS FOR PERMEABILITY CONTROL IN WATER FLOODING,
Mobil Oil Corp., New York.
K. D. Schmitt.
U. S. Patent No. 4,582,137; April 15, 1986, 6 p, 1 tab, 2 ref. Official Gazette of the United States Patent Office, Vol 1065, No 3, p 1162-1163, April 15, 1986.

Descriptors: *Patents, *Oil recovery, *Oil reservoirs, *Surfactants, *Permeability, *Injection, Flooding, Polymers.

Oil is recovered in subterranean formations having two or more zones that differ in their permeability. Permeability in very high permeability zones is reduced to force subsequently injected oil displacing fluids to pass into zones which were originally of lower permeability. The process comprises injecting an aqueous solution containing oil displacing fluid into the formation so that the fluid passes through at least one of the more permeable strata and displaces oil therein; and injecting a surfactant containing oil displacing fluid into the formation to reduce the permeability of the oil depleted highly permeable zone. (Cremmins-AEPCO)
W88-04797

SELF-PROPELLED JET AERATOR,
Georgia Tech Research Corp., Atlanta.
For primary bibliographic entry see Field 5D.
W88-04800

PROCESS AND APPARATUS FOR ION EXCHANGE BY USE OF THERMALLY REGENERABLE RESIN,
Rohm and Haas Co., Philadelphia, PA.
For primary bibliographic entry see Field 3A.
W88-04812

APPARATUS FOR ELIMINATION OF BIOFOULING,
Mitsubishi Electric Corp., Tokyo (Japan).
N. Tabata, S. Nakayama, K. Namba, and S. Yamauchi.
U. S. Patent No. 4,552,659; November 12, 1985, 6

p, 4 fig. Official Gazette of the United States Patent Office, Vol 1060, No 2, p 781-782, November 12, 1985.

Descriptors: *Patents, *Water treatment, *Water pollution control, *Biodegradation, *Ozonation, *Cooling water, Water cooling, Algae, Algal control, Shellfish, Powerplants, Ozone, Clogging.

Clogging from biofouling in the water conduit condenser tubes of a power plant cooling system is eliminated by continuously feeding ozone. A residual ozone concentration of about 0.1 ppm is maintained by feeding the ozone at a rate corresponding to the residual ozone and the ozone consumed by the oxidation of impurities. The rate of ozone feed is several times that of the effective residual ozone concentration of about 0.5 ppm. Elimination of the deposition and propagation of shellfish and algae on the walls of the cooling water system avoids water pollution, but is economically unfeasible for industrial operation because the ozone costs four times more than chlorine. (Cremmins-AEPCO)
W88-04813

REDUCING TURBIDITY IN TURBID WATERS,
Nalco Chemical Co., Oak Brook, IL.
S. W. Huang.
U. S. Patent No. 4,450,092; May 22, 1984, 4 p. Official Gazette of the United States Patent Office, Vol 1042, No 4, p 1666, May 22, 1984.

Descriptors: *Patents, *Water treatment, *Chemical coagulation, *Turbidity, *Clarification, Chemical treatment, Chlorides, Sulfates, Solubility, Polymers.

Compositions for reducing turbidity are based on coagulating finely divided solids. The compositions are prepared by mixing or blending water soluble compounds and a water soluble organic positively charged polymeric coagulant. Examples of the water soluble compounds are aluminum chloride, aluminum sulfate, ferric chloride, or ferric sulfate. The positively charged coagulant is polydiallyl dimethylammonium choloride polymer. The composition is effective in treating waters having a turbidity of 20 nephelometric turbidity units. (Cremmins-AEPCO)
W88-04829

PROCESS AND APPARATUS FOR THE CHEMICAL-MECHANICAL TREATMENT AND PURIFICATION OF GROUNDWATERS, SURFACE WATERS AND EFFLUENTS,
Passavant-Werke Michelbacher Huette, Aarbergen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W88-04832

GETTING THE LEAD OUT: REDUCING LEAD CONCENTRATION IN WATER,
M. Cousino, J. Bacharach, and J. Heine.
Public Works PUOAH, Vol. 118, No. 11, p 68-70, November 1987. 2 fig.

Descriptors: *Lead, *Corrosion, *Metal pipes, *Solder, *Flux, *Flushing, Liming, Hydrogen ion concentration, Corrosion control, Cost analysis, Water treatment.

Measures taken to deal with the problem of lead in the water system of South Junior High School, Eau Claire, Wisconsin, are described. Investigation of other systems in the community showed that lead was high elsewhere and that flux containing lead was used by about 80% of local plumbers. Hot water systems, however, did not contain high levels. With this fact in mind, local officials flushed the cold water pipes of South Junior High with hot water; large amounts of flux were removed by this process. In addition, the city public works department is now adding lime to the water to raise the pH, thus lowering the aggressiveness of the water. The linear polyphosphate corrosion inhibitor, sold as Aqua Mag, was added to the water system also aided in bringing down lead levels throughout the city. The present chemical addition program in Eau Claire costs $10,000 annually to treat an average flow of 9 million gal/day. (Rochester-PTT)
W88-04874

WATER DISTRIBUTION WITHOUT STORAGE,
Keizer City Water Dept., OR.
J. W. Nightengale, W. C. Light, E. Butts, and C. Harrison.
Public Works PUOAH, Vol. 118, No. 12, p 35-36, December 1987. 1 tab.

Descriptors: *Water distribution, *Network design, Pumps, Hydropneumatic storage, Elevated storage, Cost analysis, Control systems, Aquifer, Electric power costs, Well function.

The water distribution system in Keizer, Oregon, has no elevated storage and only 15,000 gallons of ground level hydropneumatic storage. It uses 13 wells to supply about 20,000 people. This system is described in terms of energy considerations, pump controls, peak demands and auxiliary power, comparative costs, and operating flexibility. A cost comparison of water distribution systems with and without storage shows that first costs are about $ 1.5 million less for the system without storage, but the annual costs are about $ 20,000 higher, which is mainly due to the difference in electricity costs. One 180-gallon/min pump runs continuously, and the sequencing of the other pumps is accomplished by a ladder logic programmable controller. There are both central and local controllers in the Keizer system. The characteristics that make distribution without storage practical are a high-yield aquifer directly under the distribution network, no high ground, low cost reliable electrical power, and readily available well sites. (Rochester-PTT)
W88-04875

PUBLIC OPINION ON WATER REUSE OPTIONS,
California Univ., Berkeley. School of Public Health.
For primary bibliographic entry see Field 5D.
W88-04883

DEVELOPMENT OF REGULATIONS FOR RADIONUCLIDES IN DRINKING WATER,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5G.
W88-04981

EXTREME LEVELS OF 222-RN AND U IN A PRIVATE WATER SUPPLY,
Maine Univ., Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-05002

RADIUM-226 AND RADON-222 IN DOMESTIC WATER OF HOUSTON-HARRIS COUNTY, TEXAS,
Texas Univ. Health Science Center at San Antonio.
For primary bibliographic entry see Field 5B.
W88-05003

RADON IN WATER SUPPLY WELLS: TREATMENT FACILITY REQUIREMENTS AND COSTS,
Pirnie (Malcolm), Inc., Paramus, NJ.
D. J. Hiltebrand, J. E. Dyksen, and K. Raman.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 521-534, 3 fig, 3 tab, 10 ref.

Descriptors: *Radon, *Water supply, *Water treatment, *Water quality control, Groundwater pollution, Air pollution, Drinking water, Activated carbon, Aeration, Costs, Economic aspects.

Radon-222 is an inert, noble gas that is formed by the radioactive decay of the element radium-236. Radon can enter the drinking water supply from radioactive mining operations, industrial discharge or the decay of naturally occurring radium within the local bedrock. Most often, Rn occurs naturally in groundwater as a result of the decay of Ra in water and in the rock and soil matrix surrounding the water. The concentration of radon in water supplies ranges from the background levels of < 50 pCi/l), which is normally found in the surface supplies, to > 1,000,000 pCi/l in drilled wells. Although both granulated activated carbon (GAC) and packed tower aeration have been identified as the most effective technologies for the removal of Rn from drinking water, the long empty bed contact times can result in the need for a larger number of contactors than would be practical. Based upon the facility requirements and costs it would appear that packed tower aeration will become the most viable treatment alternative. However, the selection of a particular treatment method to remove Rn will need to include an evaluation of the potential air quality concerns created by the exhaust gases from the aeration system which will contain Rn. (See also W88-04980) (Lantz-PTT)
W88-05011

OCCURRENCE AND TREATMENT OF URANIUM IN POINT OF USE SYSTEMS IN COLORADO,
EDC, Inc., Lakewood, CO.
F. T. Varani, R. T. Jelinek, and R. J. Correll.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 535-546, 3 fig, 3 tab, 9 ref.

Descriptors: *Colorado, *Water quality control, *Uranium, *Water treatment, *Water pollution sources, Groundwater quality, Ion exchange, Brines, Radioactivity, Drinking water, Alpha radiation, Spectroscopy, Economic aspects, Costs.

Two wells with gross alpha and uranium concentrations of concern were included in this two year investigation. Discussed are the 234-U/238-U ratios observed in the area, present loading and regeneration results from pilot and full-scale ion exchange systems, and techniques for disposal of radioactive regenerant brines. Although maximum contaminant levels (MCLs) for uranium have not been adopted at this time, the school district decided to implement a system to remove uranium from water used for drinking and other purposes at several facilities. The following conclusions were drawn: (1) If all the contributors to the gross alpha activity of a water cannot be accounted for using common techniques for uranium analysis, the alpha-spectroscopic analysis should be used to determine the individual contributions from 234-U and 238-U; (2) Consistent removal of high levels of gross alpha activity from well water to levels acceptable for drinking water may be accomplished at reasonable cost for small systems with conventional water softening equipment employing a strong base anionic ion exchange resin; and (3) Disposal of uranium-laden brines is site-specifics with costs and methods of disposal driven by safety and regulations. (See also W88-04980) (Lantz-PTT)
W88-05012

RESPONDING TO CUSTOMER CONCERNS ABOUT HOME TREATMENT DEVICES,
San Jose Water Co., CA.
R. S. Yoo.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 34-38 , October 1987. 2 fig, 3 ref.

Descriptors: *Point-of-entry treatment, *Water treatment, Bottled water, Drinking water, Education, Consumer protection, Water users, Utilities.

Although utilities are not in competition with bottled water or home water treatment device suppliers, part of a utility's responsibility is to ensure that customers are not subjected to false or misleading information. Unscrupulous salespeople can cause serious public relations problems for water utilities.

Utilities must determine (1) how to educate their customers about tap water quality, and (2) how to deal with fraudulent advertising practices associated with bottled water or home treatment device promotions. A proactive approach to education and a commitment to take action against false advertisers are necessary elements of an effective public awareness campaign. (Rochester-PTT)
W88-05081

ORGANIZING WATER QUALITY DISTRICTS IN NEW YORK STATE,
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
M. E. Burke, and G. A. Stasko.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 39-41, October 1987. 1 fig.

Descriptors: *Point-of-entry treatment, *Water treatment, *Drinking water, *Public utility districts, New York, Legislation.

The state of New York has passed enabling legislation for the formation of water districts that carry out point-of-entry treatment device programs in cases of private well contamination. Guidelines have been developed to assure that the devices are properly installed, operated, and maintained by the water districts once they are organized. This program is expected to ensure safe drinking water for about 3 million people at reasonable cost. The following aspects of this program are discussed: legislation, implementation, regulations, approval procedure, operational requirements, program development, water quality treatment districts, and future applications. (Rochester-PTT)
W88-05082

TESTING AND EVALUATING POINT-OF-USE TREATMENT DEVICES IN CANADA,
Health and Welfare Canada, Ottawa (Ontario). Environmental Health Centre.
R. S. Tobin.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 42-45, October 1987. 23 ref.

Descriptors: *Drinking water, *Point-of-use treatment, *Water treatment, Canada, Water treatment facilities, Public Health, Disinfection, Ozonation, Chlorination, Distillation, Reverse osmosis, Ceramic candle filters, Education.

The role of the Department of National Health and Welfare (NHW, Canada) in protecting users of point-of-use treatment devices in Canada is described. History of NHW involvement, involvement with other agencies, activated carbon devices, water softeners, the program of testing and evaluation of disinfection devices (UV light, ceramic candle filters, ozonation, iodination, chlorination, distillation, and reverse osmosis), and assessment of devices are covered. Although there is no specific regulation governing point-of-use devices, voluntary compliance with NHW recommendations has been at least partially responsible for improving the correspondence between claims made and performance of the devices on the market. Many types of water treatment devices have been tested and some of the advantages and disadvantages of each are described. A series of publications on these devices has helped to inform the scientific and lay population of their correct application. (Rochester-PTT)
W88-05083

POINT-OF-USE TREATMENT FOR TURBIDITY REMOVAL IN A MUNICIPAL SYSTEM,
URS Co., Colorado Springs, CO.
D. F. Greve, and R. L. Fultz.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 46-52 , October 1987. 5 fig, 4 tab, 11 ref.

Descriptors: *Drinking water, *Point-of-use treatment, *Turbidity, *Water treatment, Water treatment facilities, Pilot study, Safe Drinking Water Act, Wyoming, Regulations.

Point-of-use treatment was evaluated as a method for providing water in compliance with federal regulations to consumers served by unfiltered transmission mains in Sheridan, Wyoming. The study reviewed current regulatory requirements for point-of-use treatment and point-of-use technologies and equipment for turbidity removal. A pilot test was conducted to evaluate the potential of point-of-use devices to provide a reliable and economical means of meeting regulatory requirements. The results of the pilot program together with the evaluation of regulatory requirements indicated that point-of-use treatment is not a feasible means of providing potable water to taps on the Sheridan municipal system upstream of the water treatment plant. Reasons for rejection include inadequate capacity of available devices, inability to meet the Safe Drinking Water Act Turbidity standard consistently, extremely high maintenance costs, and likelihood that the proposed system would prove unacceptable to the Environmental Protection Agency. (Rochester-PTT)
W88-05084

POINT-OF-USE AND POINT-OF-ENTRY DRINKING WATER TREATMENT,
Olin Corp., Cheshire, CT. Olin Research Center.
L. T. Rozelle.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 53-59, October 1987. 7 tab, 40 ref.

Descriptors: *Drinking water, *Point-of-use treatment, *Point-of-entry treatment, *Water treatment, Water treatment facilities, Activated carbon, Particulate filters, Adsorptive filters, Ion exchange, Distillation, Reverse osmosis, Cost analysis, Bacteria.

Point-of-use and point-of-entry water treatment systems that utilize tested and proven methods are an effective alternative to conventional systems for the reduction of chemical contaminants to acceptable levels. Reverse osmosis is the most universally effective technology for reducing inorganic contaminants. Adsorption by activated carbon is the most universally effective method for reducing organic contamination. Several technologies (particulate filters, adsorptive filters, reverse osmosis, ion exchange, and distillation) and their placements (countertop, faucet-mounted, undersink cold tap, and undersink line by-pass) are discussed. Field studies concerning point-of-use and point-of-entry water treatment show this technology to be effective for community application. Thus far, bacterial growth in these devices has not been shown to be a health problem. Preliminary cost information indicates the advantages of point-of-use systems, especially for small communities. (Author's abstract)
W88-05085

MICROBIOLOGICAL CHARACTERISTICS OF THIRD-FAUCET POINT-OF-USE DEVICES,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
D. J. Reasoner, J. C. Blannon, and E. E. Geldreich.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 60-66, October 1987. 12 fig, 2 tab, 17 ref.

Descriptors: *Point-of-use treatment, *Drinking water, *Bacterial analysis, *Water treatment, Silver, Copper, Disinfection, Carbon filters, Water treatment facilities, Heavy metals, Bactericides.

Studies of third-faucet point-of-use treatment devices indicated that the bacteriological quality of product water varies among units of the same design as well as among units of different design. The development of bacterial populations is affected by the length of time a filter cartridge is service, water temperature, flow rate, materials of construction, and the quality of the influent water. Although some units contain silver as a bacteriostatic agent, its effectiveness is questionable because the concentrations of heterotrophic bacteria associated with such units are often as high as those from units that do not contain silver. (Author's abstract)
W88-05086

MICROBIOLOGICAL CHARACTERISTICS OF POINT-OF-USE PRECOAT CARBON FILTERS,
Everpure, Inc., Westmont, IL.
P. Regunathan, and W. H. Beauman.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 67-75, October 1987. 4 fig, 9 tab, 32 ref.

Descriptors: *Point-of-use treatment, *Water treatment, *Carbon filters, *Drinking water, *Coliforms, *Viruses, *Protozoa, Silver, Copper, Water treatment facilities, Heavy metals, Bactericides.

Experiments conducted with commercial point-of-use precoat carbon filters showed that these filters can significantly and consistently reduce the heterotrophic plate count (HPC) coliforms, enteric viruses, and protozoan cysts in water. Although the effect of silver in the precoat filters on HPC organisms was inconclusive, the presence of silver dramatically reduced coliform levels. The antimicrobial effect of copper in these filters was similar to, but much less than, that of silver. (Author's abstract)
W88-05087

POINT-OF-USE AND POINT-OF-ENTRY TREATMENT ON LONG ISLAND,
ERM-Northeast, Inc., Plainview, NY.
J. A. DeFilippi, and J. H. Baier.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 76-81, October 1987. 3 fig, 9 tab, 6 ref.

Descriptors: *Point-of-use treatment, *Water treatment, *Point-of-entry treatment, *Drinking water, Nitrates, Aldicarb, Agricultural chemicals, Long Island, New York, Water treatment facilities, Aquifers, Pollution, Cost analysis.

A home demonstration project with point-of-use and point-of-entry devices on the North Fork of Long Island, New York, showed that this type of water treatment is applicable in areas where development is not intensive and where homes are served by individual wells. The home demonstration project involved monitoring the performance of 18 installed units in an area of Long Island where the aquifer is contaminated with aldicarb and other agricultural chemicals and where nitrates greater than 10 mg/l occur in 16-17% of wells and 5-10 mg/l occur in another 26-31%. Average annual cost/home of point-of-use devices are estimated at $225-290. Because control and monitoring of point-of-use and point-of-entry systems are the keys to protecting public health, these systems should not be allowed to evolve without regulation. (Rochester-PTT)
W88-05088

CONTROLLING ARSENIC, FLUORIDE, AND URANIUM BY POINT-OF-USE TREATMENT,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
K. R. Fox, and T. J. Sorg.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 81-84, October 1987. 3 fig, 5 tab, 4 ref.

Descriptors: *Point-of-use treatment, *Drinking water, *Arsenic, *Water treatment, *Fluoride, *Uranium, *Reverse osmosis, *Ion exchange, Activated alumina, Activated carbon, Water treatment facilities, Heavy metals, Taste, Beryllium, Mercury, Selenium, Lead, Cadmium, Chromium, Dissolved solids.

Characteristics of point-of-use devices suitable for removing inorganic contaminants are described. Five techniques are in use for point-of-use treatment: reverse osmosis, activated alumina systems, ion exchange systems, granular activated carbon systems, and distillation. The Environmental Protection Agency has approved the first three of these for inorganic contaminant removal; laboratory and field studies with these units were conducted. Ion exchange and activated alumina units employed in Alaska and Oregon performed well when the media were properly prepared. Removals by low-pressure reverse osmosis units were

good, but could not bring extremely high As (1.08 mg/l) to less than the maximum contaminant level (MCL). High pressure units worked well, however. Point-of-use RO systems in San Ysidro, New Mexico, are lowering influent As and F levels to below the MCLs. Unexpected coliforms were found in three units. Taste of the water was improved by RO. Anion exchange systems in Colorado and New Mexico performed well in lowering U concentrations in different water supplies from a range of 22-104 ug/l to <2 ug/l. A laboratory study with a point-of-use unit showed excellent removal of Be, Hg, Se (IV and VI), Pb, Cd, Cr, (III and VI), and F, as well as lowering total dissolved solids and other natural constituents. (Rochester-PTT)
W88-05089

MODELING POINT-OF-ENTRY RADON REMOVAL BY GAC,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry and, and S. B. Lowry.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 10, p 85-88, October 1987. 7 fig, 3 tab, 28 ref.

Descriptors: *Water treatment, *Point-of-use treatment, *Drinking water, *Radon, *Activated carbon, Carbon filters, Water treatment facilities, Cost analysis, Aeration, Radioisotopes.

A design model for point-of-entry granular activated carbon (GAC) removal of 222Rn from drinking water was developed and GAC technology was installed and monitored in more than 100 homes across the United States. More than 85% of the units employ carbon D and 10% use carbon C. Eighty percent of all units are in the 1.7-cu ft category, with the rest in the 1-3 cu ft range. Three units malfunctioned, probably due to shifting of support gravel in transit leading to GAC channeling. Removal of the results from these units from the data base leads to an average 222Rn removal figure of 98.9%. A number of factors have prevented aeration from becoming as popular as GAC in point-of-entry 222Rn removal. These include: the requirement to repressurize the water supply, an installed cost more than three times that of GAC, limited removal capabilities of some aeration methods, and a significant maintenance requirement, which increases the cost differential with time. (Rochester-PTT)
W88-05090

5G. Water Quality Control

COMPLYING WITH LAND APPLICATION REGULATIONS,
Bio Gro Systems, Inc., Annapolis, MD.
For primary bibliographic entry see Field 5E.
W88-04512

QUALITY GROUNDWATER FOR TOMORROW,
Miljoestyrelsen, Copenhagen (Denmark).
J. Forslund.
Water Resources Journal, No. 152, p 7-9, March 1987. 2 fig.

Descriptors: *Water quality control, *Groundwater pollution, *Groundwater quality, *Water pollution control, Nitrates, Denmark, Water quality control, Pesticides, Fertilizers, Drinking water, Water supply, Regulations.

Groundwater has long been considered a source of safe drinking water. In general, it is better protected and of higher chemical quality than surface water. During recent decades, however, changing activities at the soil surface have influenced the quality of groundwater. Denmark has a large agricultural sector with statistics on land use, the use of fertilizers and pesticides, groundwater and rain water quality covering many years. A comprehensive study of nitrate concentrations in groundwater was carried out in 1983 by the Danish Agency for Environmental Protection with assistance from the regional authorities. The study was based on the analysis of samples of groundwater from some 10,000 wells and of samples of drinking water from 2,800 groundwater supply systems throughout the country. A time-series analysis showing trends of nitrate concentrations in drinking water from 1984 waterworks has been completed. These statistics indicate that the pollution of groundwater in Denmark is due primarily to the increase in nitrate concentration. In some areas, increasing acidification has also been noticed. The growing use of pesticides in agriculture will increase the degree of pollution of groundwater. The risk of groundwater deterioration is definitely escalating. Measures to avert the threat of pollution through the ever-increasing use of fertilizers and pesticides must be implemented before it is too late. An action plan against the further pollution of groundwaters by nitrate and organic compounds was initiated by the Danish Government in 1985. It provides for restricting the application of manure and setting limits for dunghills and silage stores in order to stop percolation. In addition, intensive research programs, aimed at the reduction of nitrate release, will be carried out for a period of three years. (Lantz-PTT)
W88-04513

ABANDONED WELLS: HOW ONE STATE DEALS WITH THEM,
Minnesota Dept. of Health, Minneapolis.
J. D. Nye.
Water Well Journal WWJOA9, Vol. 41, No. 9, p 42-46, September 1987. 2 tab.

Descriptors: *Abandoned wells, *Minnesota, *Well seepage, *Water pollution prevention, Well casings, Grouting.

Abandoned wells are water wells whose use has been discontinued or are in such disrepair that continued use is impractical or hazardous. Unsealed abandoned wells can act as conduits or channels for contamination to reach groundwater. The threat of open holes serving as passageways for surface or near-surface contamination poses a major problem to groundwater. The total number of abandoned well can be visualized by realizing that approximately 100,000 to 400,000 active wells are estimated to exist in the state of Minnesota. The abandoned well program has been one of the target projects for extra effort by the Minnesota Department of Health because of the recognition of its importance in protecting groundwater. Recognizing that a large number of abandoned wells exist with varying hazards, an abandonment priority has been developed: (1) Major well abandoned efforts have been the target for abandoned wells located in areas of major pollutant discharge or where wells intercept contamination plumes; (2) Developments with private wells annexed by and connected to municipal water systems since cross-connection hazard exists between the water systems; (3) Demolition, rehabilitation or construction areas or where there are problems of scheduling proper sealing while access is available; (4) Wells improperly constructed, located or maintained. Wells with faulty seals or casings, multi-aquifer wells, recharge or disposal wells, wells near contamination sources such as septic systems; (5) Wells in geologically sensitive areas, wells completed in or through carbonates (limestone); and (6) All other abandoned wells. Sealing and inspection of abandoned wells, sampling of water from abandoned wells in industrial or commercial areas, casing removal, grouting, and writing on abandoned well reports are further highlights of this paper. (Lantz-PTT)
W88-04526

ACCURACY AND PRECISION ENHANCEMENT FOR TOTAL RESIDUAL CHLORINE BACK TITRATION,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
L. A. Stockmeier, C. O. Huber, and J. E. Kohl.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 12, p 1075-1077, December 1987. 2 fig, 1 tab, 4 ref.

Descriptors: *Chemical analysis, *Titration, *Chlorine, Phenylarsine oxide, Iodine, Amperometry, Precision.

The quantitative determination of chlorine by back titration with iodine after addition of known excess phenylarsine oxide (PAO) in pH 4 acetate buffered solution is a recognized standard method for total residual chlorine determination. Titration, as opposed to color comparison or spectrophotometric procedures, eliminates error due to coloration of the sample and provides direct calibration by standardized titration reagents. The back titration procedure, in contrast to the total residual chlorine potentiometric electrode probe or the forward titration, prevents iodine losses by: iodine volatility, reducing agents, substitution and addition reactions with organic compounds, and forming iodate using bromine in sea water. The 'Standard Method' procedures use reagent concentrations such that the titration end point range for 0.00 to 0.50 mg/l is only 0.10 ml of the 0.0282 N iodine titrant. Even when the recommended 0.01 ml division buret is used, relative errors in the final results can be unacceptably high because of uncertainties in end point location, titrant volume increments caused by individual titrant drops, and buret reading. Clearly, these relative errors could be decreased if a lower concentration iodine titrant with the corresponding larger titrant volumes were specified. A lower concentration has not been designated for two probable reasons. One reason is sensitivity of locating the end point, especially when using the starch visual indicator procedure. The other reason is doubt about the storage stability of iodine titrant solutions which are more dilute than the specified standard 0.0282 N concentration. This paper describes studies that compared the stability of a 'Standard Methods' iodine titrant with a five-fold diluted titrant over a number of weeks and examined end point indication and titrant delivery errors. The results suggest how to obtain better precision and thus allow reliable measurements at the lower concentrations currently of interest (i.e., well below 0.10 mg/l). (Lantz-PTT)
W88-04590

STOCHASTIC WATER QUALITY OPTIMIZATION USING IMBEDDED CHANCE CONSTRAINTS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
J. H. Ellis.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2227-2238, December 1987. 6 fig, 82 ref.

Descriptors: *Water quality, *Optimization, *Stochastic analysis, *Cost allocation, *Mathematical models, Biological oxygen demand, Dissolved oxygen, Flow rates, Simulation analysis, Mathematical analysis, Streamflow.

A chance-constrained stochastic programming model is developed for water quality optimization. It determines the least cost allocation of waste treatment plant biochemical oxygen demand (BOD) removal efficiencies, subject to probabilistic restrictions on maximum allowable instream dissolved oxygen deficit. The new model extends well beyond traditional approaches that assume streamflow is the sole random variable. In addition to streamflow, other random variables in the model are initial instream BOD level and dissolved oxygen (DO) deficit; waste outfall rates, BOD levels and DO deficits; deoxygenation k sub 1, reaeration k sub 2, and sedimentation-scour rate k sub 3 coefficients of the Streeter-Phelps DO sag model; photosynthetic input-benthic depletion rates A sub i, and nonpoint source BOD input rate P sub i for the Camp-Dobbins extensions to the Streeter-Phelps model. These random variables appear in more highly aggregated terms which in turn form part of the probabilistic constraints of the water quality optimization model. Stochastic simulation procedures for estimating the probability density functions and covariances of these aggregated terms are discussed. A new chance-constrained programming variant, imbedded chance constraints, is presented along with an example application. In effect, this method imbeds a chance constraint within a chance constraint in a manner which is loosely associated with the distribution-free method of chance-constrained programming. IT permits the selection of unexpected value realizations of the mean and variance estimates em-

ployed in the deterministic equivalents of traditional chance-constrained models, and provides a convenient mechanism for generating constraint probability response surfaces. A joint chance-constrained formulation is also presented which illustrates the possibility for prescription of an overall system reliability level, rather than reach-by-reach reliability assignment. (Author's abstract)
W88-04603

FIGHT AGAINST EUTROPHICATION IN THE INLET OF 'ODENSE FJORD' BY REAPING OF SEA LETTUCE (ULVA LACTUCA),
Municipality of Odense (Denmark). Odense Magistrat.
O. T. Frederiksen.
Water Science and Technology WSTED4, Vol. 19, No. 10, p 81-87, 1987. 4 fig, 2 tab.

Descriptors: *Water quality control, *Wastewater treatment, *Eutrophication, *Odense Fjord, *Sea lettuce, Aquatic plants, Macrophytes, Pollution load, Denmark, Nitrogen, Phosphorus, Nutrients.

Odense, which is the third largest city in Denmark, is situated at the head of the inlet of 'Odense Fjord' - a shallow inlet area of 54 sq km. Including the discharge of industrial wastewater, the total wastewater load corresponds to approximately 400,000 p.e., which is treated in a mechanical/biological treatment plant. There is currently considerable plant production in the inlet, especially of macrophytes, such as Ulva lactuca (Sea Lettuce). The Municipality of Odense is extending its wastewater treatment to include the removal of nutrient salts, nitrogen and phosphorus. Calculations of the total discharge to the inlet show that 80% of the nitrogen and 20% of the phosphorus load are derived from the catchment area which has an intensive agricultural production. In an attempt to reduce this discharge, tests have been made of reaping of Ulva lactuca in the inlet, and calculations of the effects of the reaping have been carried out. It appears that if sea lettuce is reaped in a quantity corresponding to approximately 8000 tons dry matter (DM)/year, this will result in an improvement of the wastewater treatment; to 5 mg/l in the effluent for nitrogen. The corresponding figures for phosphorus are approximately 20,000 tons DM/yr and 30,000 tons DM/yr, and 2 mg/l and 0.3 mg/l, respectively. (Lantz-PTT)
W88-04621

UTILIZATION OF WATER HYACINTH FOR REMOVAL AND RECOVERY OF SILVER FROM INDUSTRIAL WASTEWATER,
Instituto Nacional de Tecnologia, Rio de Janeiro (Brazil).
For primary bibliographic entry see Field 5D.
W88-04622

GREAT LAKES CLEANUP EFFORT: MUCH PROGRESS, BUT PERSISTENT CONTAMINANTS REMAIN A PROBLEM,
B. Hileman.
Chemical and Engineering News, Vol. 66, No. 6, p 22-27, February 1988. 2 fig, 2 tab.

Descriptors: *Lake restorations, *Great Lakes, *Toxins, *Decontamination, *Cleanup, *Ecosystems, Environmental policy, Interagency cooperation, Pathology, Teratogenicity, Birds, Fish, Mammals, Public health.

The Great Lakes Basin is an ecosystem of unparalleled complexity. Author reviews recent attempts to address persistence of toxic substances in the Lakes. Attempts by U.S. and Canadian governments to restrict influx of various toxic contaminants are discussed, as well as recent large-scale outbreaks of pathology and teratogenicity among the Lakes' fish, bird and mammal communities. Also covered are perceived human health effects from exposure to toxics in the Great Lakes, industrial sources of various toxins, attempts to upgrade wastewater treatment in the area, and new plans for implementing cleanup of government-identified 'areas of concern.' The author concludes that while the cleanup effort in the Great Lakes Basin has made substantial progress since it was first initiated in 1972, solving the problem of persistent toxic substances will take many more years. (Friedmann-PTT)
W88-04659

PROCEEDINGS OF THE SEVENTEENTH MISSISSIPPI RESOURCES CONFERENCE.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 6B.
W88-04665

REGULATIONS FOR IMPLEMENTING THE PROCEDURAL PROVISIONS OF THE NATIONAL ENVIRONMENTAL POLICY ACT.
Council on Environmental Quality, Washington, DC.
For primary bibliographic entry see Field 6E.
W88-04705

HYDROLOGY AND POLLUTANT REMOVAL EFFECTIVENESS OF WETLAND BUFFER AREAS RECEIVING PUMPED AGRICULTURAL DRAINAGE WATER,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5C.
W88-04742

FINANCING WATER AND SEWER EXTENSIONS IN URBAN GROWTH AREAS: CURRENT PRACTICES AND POLICY ALTERNATIVES,
North Carolina Univ., Chapel Hill. Center for Urban and Regional Studies.
For primary bibliographic entry see Field 6C.
W88-04746

RISK ASSESSMENT FOR THE PROTECTION FROM AND THE PREVENTION OF GROUNDWATER CONTAMINATION,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
Y. Y. Haimes, and V. Chankong.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116819/AS. Price codes: A13 in paper copy, A01 in microfiche. Final report to U.S. Geological Survey, Reston, VA, April 1987. 271 p, 40 fig, 21 tab, 204 ref. Project No. 14-08-0001-G1067.

Descriptors: *Risks, *Groundwater pollution, *Groundwater management, Computer models, Multiobjective planning, Model studies, Evaluation.

A methodological framework is presented for dealing with uncertainty associated with sources of groundwater contamination. In particular, the framework describes how risks (due to groundwater contamination and resulting from these uncertainties) can be assessed for any given prevention and/or correction management policy. The process of risk assessment, which is composed of risk identification, risk quantification, risk evaluation, and risk acceptance and management, was followed. The aim in developing appropriate statistical models that would describe major sources of contamination (such as waste disposal) was not achieved due to inadequate availability of empirical data. For both the prediction and correction problems, groundwater models were required to compute the movement of contaminants from sources to supply wells. This approach does not work well for the correction problem because of the inherent nonlinearity introduced by varying pumping and injection rates. Special techniques for dealing with bilinear time-varying distributed multi-objective systems were investigated. These include optimal pointwise control, successive linear approximation, and multiobjective dynamic programming. Despite the voluminous documentation in this report, some of the work presented is mostly exploratory. A general framework for assessing risk of groundwater contamination was developed to guide the research, but only exploratory investigation of ideas to implement each step in the framework was possible. Clearly more work is needed to fine-tune and synthesize the ideas to produce a useful workable modeling and decision-making package. (USGS)
W88-04750

ORGANIC COMPOUND EFFECTS ON SWELLING AND FLOCCULATION OF UPTON-MONTMORILLONITE,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
S. Chen, P. F. Low, J. H. Cushman, and C. B. Roth.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-104708/AS. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. 178, July 1987. 28 p, 10 fig, 39 ref. Contract No. 14-08-0001-G1016. Project No. USGS G1016-04.

Descriptors: *Transport processes, *Organic chemicals, *Clays, *Flocculation, Permeability, Swelling clays, Deflocculation, Upton-Montmorillonite, Dioxane, Organic compounds.

The swelling and shrinking and flocculation and deflocculation of clays is of fundamental importance in the transport of solutes through a porous medium because these processes affect the permeability of the medium. Since organic solutes frequently occur in toxic wastes, an investigation was conducted of the effect of eight soluble organic compounds, representing different kinds of structures and functional groups, on the swelling and flocculation of sodium saturated Upton-Montmorillonite. These compounds were ethanol, 1,4-dioxane, phenol, urea, benzamide, ethylamine hydrochloride, acetic acid, and sodium acetate. In general, the compounds which ionize in water exerted a greater effect than those that remain unionized, i.e., electrically neutral. However, 1,4-dioxane, was exceptional in that, despite its electrical neutrality, it reduced swelling and increased flocculation significantly. Possible reasons for the effects of the different compounds on swelling and flocculation were advanced. (Cushman-Purdue U., WRRC)
W88-04759

WATER AERATION AND CIRCULATION APPARATUS,
P. A. Freeman.
U. S. Patent No. 4,308,137; December 29, 1981, 7 p, 5 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1013, No 5, p 1802-1803, December 29, 1981.

Descriptors: *Reaeration, *Water pollution treatment, *Lake restoration, *Patents, *Aeration, *Aerators, *Water quality control, *Oxygenation, Water circulation, Bubbles, Flotation, Dissolved oxygen, Oxygen deficit, Oxygen balance, Flushing.

A self-contained and portable water aeration and circulation apparatus improves or maintains water quality in natural or man-made bodies of water. A single driving unit is connected to a water circulating or agitation device well below the surface of the body of water and, optionally, a bubble generator operating at the water surface. A mount assembly includes flotation and stabilizing components to maintain the assembly in an upright condition throughout variations in the tidal flow or water current so that the water circulation device continuously induces a downward flow of naturally oxygen-saturated surface water, which mixes with oxygen-deficient bottom water to increase dissolved oxygen and provide bottom flushing action. Optionally, during the operation of the driving system, the bubble generator augments the action of the water circulation device by introducing small air bubbles into the flow stream from which oxygen dissolves directly into the bottom water. (Cremmins-AEPCO)
W88-04791

APPARATUS FOR ELIMINATION OF BIOFOULING,
Mitsubishi Electric Corp., Tokyo (Japan).
For primary bibliographic entry see Field 5F.
W88-04813

CRITERIA FOR PROJECT PERFORMANCE CERTIFICATION,
Water Pollution Control Federation, Alexandria, VA.
For primary bibliographic entry see Field 5D.
W88-04880

MINIMIZING LIABILITIES FACING POTWS,
Zorc, Risseto and and Weaver, Washington, DC.
For primary bibliographic entry see Field 5D.
W88-04881

INDUSTRY INITIATES SOURCE PREVENTION,
For primary bibliographic entry see Field 5D.
W88-04882

REGULATION OF STORM WATER POINT SOURCE DISCHARGES,
Environmental Protection Agency, Dallas, TX. Region VI.
J. J. Korpics.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 1, p 50-56, January 1988. 2 tab.

Descriptors: *Storm water, *Public policy, *Data acquisition, *Urban runoff, *Water pollution control, Environmental Protection Agency, National Pollutant Discharge Elimination System, Regulations, Program development, Projections.

Key issues involved in the debate over regulation of storm water through the National Pollutant Discharge Eliminations System (NPDES) program are examined. The Water Quality Act of 1987 has given EPA more time and a better framework to deal with the nagging storm water control problem, but WQA also has created some new problems that probably will not become fully apparent until proposed regulations are released in 1988. Of primary importance is the notion that EPA is dealing with an infant program and must, therefore, move cautiously toward a goal of effectively controlling storm water point sources. To that end, EPA should focus on qualitative information as a first step toward addressing the storm water problem in a practical and cost-effective, yet environmentally sound, manner. The timetable for promulgation application requirements may be violated due to EPAs current tendency toward extensive sampling requirements. (Rochester-PTT)
W88-04884

DOE HIGH-LEVEL NUCLEAR WASTE REPOSITORY PROGRAM -- AQUIFER IMPACTS,
Texas Office of the Governor, Austin. Nuclear Waste Programs Office.
For primary bibliographic entry see Field 5E.
W88-04920

OIL-FIELD BRINE CONTAMINATION---A CASE STUDY, LEA COUNTY, NEW MEXICO,
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 5B.
W88-04923

WETLANDS OF THE CHESAPEAKE.
For primary bibliographic entry see Field 2L.
W88-04934

EPA AND THE CHESAPEAKE BAY,
Environmental Protection Agency, Washington, DC.
J. S. Cooper.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 30-36.

Descriptors: *Regulations, *Wetlands, *Environmental protection, *Water quality control, *Chesapeake Bay, Estuaries, Water pollution control, Ecology, Environmental Protection Agency, Public participation.

The Chesapeake Bay is a national treasure. However, its size and resources can create the impression that someone else will always be around to solve the problem of water quality and wetland protection. The Environmental Protection Agency (EPA) has addressed and will continue to address many of the water quality problems through the Clean Water Act. The Agency will continue working with other federal and state agencies as well as on wetlands protection programs and studies. Wetlands are critical to the Chesapeake Bay's health, and preservation and protection of wetlands requires a joint effort. EPA can point the way, but in the end local communities will have to make many of the key decisions that will determine the progress in cleaning up the Bay. This effort requires consideration of the following: (1) there cannot be unrestricted development and healthy wetlands; (2) large-scale industry and improved water quality cannot exist without a greater expenditure on water pollution control equipment and greater enforcement of stricter water quality standards; and (3) the ecology of the Bay, with a watershed from six states, cannot be improved without the participation and help of all six. (See also W88-04934) (Lantz-PTT)
W88-04938

ROLE OF NON-TIDAL AND TIDAL FRESHWATER MARSHES IN REDUCING NUTRIENT INPUTS IN CHESAPEAKE BAY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W88-04941

SUBMERGED AQUATIC VEGETATION IN THE CHESAPEAKE BAY: VALUE, TRENDS AND MANAGEMENT,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W88-04942

MANAGEMENT OF AGRICULTURAL DRAINAGE WATER FOR WATER QUALITY,
North Carolina State Univ., Raleigh. Dept. of Soil Science.
J. W. Gilliam.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 208-215, 5 tab, 4 ref.

Descriptors: *Water quality management, *Drainage water, Water quality, Agricultural hydrology, Management planning, Estuaries, Pollutant load, Controlled drainage, Coastal plains, Riparian vegetation, Drainage programs, Channels, Drainage effects.

Improved agricultural drainage management techniques offer a solution to the negative impacts that flow from cultivated lands can have on bays and estuaries. Though the nutrients in drainage water from agricultural lands tend only to be slightly above background levels, the aggregate loading from vast areas of cultivated lands can lead to significant nutrient loading of bays and estuaries. The greatest opportunity for management decisions to influence the quality of agricultural drainage water before it reaches estuaries or bays is in the coastal plain. In the Atlantic coastal area, the Coastal Plain supports the most intensive agriculture. Because the coastal plain lies closer to the bays and estuaries than the Piedmont and Mountains, less purification of water occurs between the fields and the estuaries. In the upper Coastal Plain where artificial drainage is not as essential, riparian vegetation between the field and stream serves to purify the agricultural drainage water. If these riparian areas are cleared, and cultivated land covers most of the land area, concentrations of nutrients in the streams will almost certainly increase. In the middle and lower coastal plains, where artificial drainage is essential for agricultural production, some new drainage water management alternatives which show considerable promise for maintaining water quality. These water management techniques appear to be very acceptable to the agricultural sector because they either increase yields or have no effect on yields. Some agricultural water management techniques which could benefit the quality of bodies of water receiving agricultural drainage water are: (1) utilization of various combinations of surface and subsurface drainage; (2) utilization of drainage control structures in field ditches; and (3) Utilization of drainage control structures in large channelized streams. (See also W88-04934) (Lantz-PTT)
W88-04953

MINIMIZING ADVERSE IMPACTS ON WETLANDS OF WATER QUALITY ASSOCIATED WITH FOREST AND AGRICULTURAL PRACTICES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
C. R. Lee.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 225-230, 2 fig, 2 ref.

Descriptors: *Water pollution control, *Agriculture, *Wetlands, *Environmental effects, *Water quality, *Forestry, Suspended solids, Nutrients, Pesticides, Agricultural runoff, Sedimentation basins, Dams, Filtration, Nitrogen, Surface runoff, Phophorus.

Several control techniques exist for reducing suspended solids, nutrients and pesticides associated with runoff from forest and agricultural operations that enters the Chesapeake Bay. Vegetated sedimentation ponds, check dams, and filtering structures can reduce suspended solids in surface runoff. Nitrogen can be absorbed by plants and undergo denitrification by surface soil mechanisms. There are four aspects of minimizing adverse impacts on wetlands of water quality associated with forest and agricultural practices that need additional research. These are: (1) demonstration of the implementation of appropriate control measures discussed above; (2) quantification of the effectiveness of these controls; (3) Determination of the assimilation capacity of wetland types; and (4) Quantification of contaminant mobility in food chains associated with various wetland systems. (See also W88-04934) (Lantz-PTT)
W88-04955

URBANIZATION, WATER QUALITY AND STORMWATER MANAGEMENT - A MARYLAND PERSPECTIVE,
Maryland Water Resources Administration, Annapolis.
R. L. Harrill.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 246-253, 1 tab, 9 ref.

Descriptors: *Urbanization, *Environmental effects, *Resources management, *Administrative regulations, *Maryland, *Stormwater runoff, *Water quality control, Management planning, Runoff, Urban runoff, Infiltration, Retention.

The changes in a hydrologic system caused by urbanization render it more susceptible to contamination by pollutants. The four stormwater management practices incorporated into the Maryland Stormwater Management Regulations set up to control runoff are, in order of their effectiveness: infiltration; vegetated swales and natural depression; 'wet' ponds; and 'dry' ponds. These methods as well as new methods are being explored and developed in an effort to develop a program requiring some form of water quality enhancement on all development projects. One study, being conducted jointly with the Fish and Wildlife Service, is focused on the development of guidelines for the design and operation of wetland areas for stormwater runoff retention. (Lantz-PTT)
W88-04959

WATER QUALITY CERTIFICATION IN MARYLAND,
Maryland Dept. of Health and Mental Hygiene, Baltimore. Office of Environmental Programs.
For primary bibliographic entry see Field 6E.
W88-04964

DEVELOPMENT OF REGULATIONS FOR RADIONUCLIDES IN DRINKING WATER,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
C. R. Cothern.
IN: Radon, Radium and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination. Proceedings of the NWWA Conference, April 7-9, 1987, Somerset, New Jersey. 1987. p 1-11, 4 tab.

Descriptors: *Regulations, *Drinking water, *Radioisotopes, Radium radioisotopes, Radon, Risks, Water pollution sources, Water systems, Water quality control.

The Office of Drinking Water in the U.S. EPA is currently reexamining existing regulations for radionuclides in drinking water and is considering the possibility of adding maximum contaminant levels (MCLs) for uranium and radon. Background analyses to support this activity include evaluations of occurrence, exposure, health effects, monitoring analytical methodology and treatment techniques. The occurrence of radium-226, radium-228, natural radium, and radon in drinking water supplies is discussed, along with possible sources of the contamination and risk estimates. (See also W88-04980) (Lantz-PTT)
W88-04981

CONNECTICUT RADON STUDY- USING LIMITED WATER SAMPLING AND A STATEWIDE GROUND-BASED GAMMA SURVEY TO HELP GUIDE AN INDOOR AIR TESTING PROGRAM. A PROGRESS REPORT:,
Connecticut Dept. of Environmental Protection, Hartford. Natural Resources Center.
For primary bibliographic entry see Field 5A.
W88-05001

EXTREME LEVELS OF 222-RN AND U IN A PRIVATE WATER SUPPLY,
Maine Univ., Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-05002

RADIUM-226 AND RADON-222 IN DOMESTIC WATER OF HOUSTON-HARRIS COUNTY, TEXAS,
Texas Univ. Health Science Center at San Antonio.
For primary bibliographic entry see Field 5B.
W88-05003

TREATMENT SCHEME FOR CONTROLLING THE MIGRATION OF RADIUM FROM A TAILINGS IMPOUNDMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5D.
W88-05009

ASSESSING THE POTENTIAL WATER QUALITY HAZARDS CAUSED BY DISPOSAL OF RADIUM-CONTAINING WASTE SOLIDS BY SOIL BLENDING,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W88-05010

RADON IN WATER SUPPLY WELLS: TREATMENT FACILITY REQUIREMENTS AND COSTS,
Pirnie (Malcolm), Inc., Paramus, NJ.
For primary bibliographic entry see Field 5F.
W88-05011

COMPARISON OF LAKE ONTARIO ZOOPLANKTON COMMUNITIES BETWEEN 1967 AND 1985: BEFORE AND AFTER IMPLEMENTATION OF SALMONID STOCKING AND PHOSPHORUS CONTROL,
Canada Centre for Inland Waters, Burlington (Ontario).
O. E. Johannsson.
Journal of Great Lakes Research JGLRDE, Vol. 13, No. 3, p 328-339, 1987. 5 fig, 5 tab, 36 ref.

Descriptors: *Zooplankton, *Water quality control, *Fish stocking effects, *Water pollution control, *Lake Ontario, *Phosphorus, Fish stocking, Water resources, Plankton, Aquatic life, Pollution load, Lakes, Population density, Population dynamics, Comparison studies, Water quality control, Ecological effects.

Two strong, contrasting management strategies were applied to Lake Ontario during the 1970s; a 40% reduction in phosphorus loadings to the lake and an exponential increase in salmonid stocking. A comparison of zooplankton community structure and abundance from 1981 to 1985 with that of earlier studies (1967 to 1972) found no detectable change in the range of abundances or community composition between the two periods. Clearly, neither management strategy has had a discernible impact on the zooplankton community to date; however, the potential for change in the system remains high. (Author's abstract)
W88-05034

RELATIVE EFFICIENCY OF AGRICULTURAL SOURCE WATER POLLUTION CONTROL POLICIES,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
J. S. Shortle, and J. W. Dunn.
American Journal of Agricultural Economics, Vol. 68, No. 3, p 668-677, August 1986. 28 ref.

Descriptors: *Water quality control, *Water pollution control, *Agricultural engineering, *Nonpoint pollution sources, *Economic aspects, Political aspects, Farm management, Soil erosion, Erosion, Hydrologic models, Model studies, Agricultural runoff, Runoff, Cost analysis, Nutrients, Soil loss.

The expected efficiencies of four general strategies for agricultural nonpoint pollution abatement are examined. These are (1) economic incentives applied to estimated runoff (e.g., a tax on estimated soil loss); (2) estimated runoff standards (e.g., estimated soil loss standards); (3) economic incentives applied to farm management practices (e.g., taxes on nutrient applications); and (4) farm management practice standards (e.g., required use of no-till). Emphasis was placed on the implications of differential information about the costs of changes in farm management practices, the impracticality of accurate direct monitoring, and the stochastic nature of nonpoint pollution. Appropriately specified management practice incentives should generally outperform the other three strategies. In addition, it is believed that management practice incentives are politically acceptable as well as economically advantageous. However, none of the four strategies can be defined to attain a first-best optimum where there are multiple sources of pollution and/or farmers are risk adverse. (Cassar-PTT)
W88-05067

WATER SUPPLY, SANITATION AND HEALTH EDUCATION PROGRAMMES IN DEVELOPING COUNTRIES: PROBLEMS OF EVALUATION,
Linkoeping Univ. (Sweden). Dept. of Pediatrics.
For primary bibliographic entry see Field 6B.
W88-05072

ORGANIZING WATER QUALITY DISTRICTS IN NEW YORK STATE,
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
For primary bibliographic entry see Field 5F.
W88-05082

TESTING AND EVALUATING POINT-OF-USE TREATMENT DEVICES IN CANADA,
Health and Welfare Canada, Ottawa (Ontario). Environmental Health Centre.
For primary bibliographic entry see Field 5F.
W88-05083

COMPARISON OF INTERNAL PHOSPHORUS LOADS IN LAKES WITH ANOXIC HYPOLIMNIA: LABORATORY INCUBATION VERSUS IN SITU HYPOLIMNETIC PHOSPHORUS ACCUMULATION,
York Univ., North York (Ontario). Faculty of Science.
For primary bibliographic entry see Field 5B.
W88-05095

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

IMPLICIT STOCHASTIC MODEL FOR RESERVOIR YIELD OPTIMIZATION,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
S. Simonovic.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2159-2165, December 1987. 6 fig, 3 tab, 18 ref.

Descriptors: *Optimization, *Reservoir yield, *Water management planning, *Stochastic process, *Hydrologic models, Stochastic hydrology, Model studies, Water yield, Hydrologic budget, Reservoir management, Mathematical models, Algorithms, Yugoslavia.

The implicit stochastic model is aimed at solving the specific problem of the optimal reservoir yield when the demand is not known. The model is created to assist in the long-term comprehensive water management planning. Knowing the character of different water demands, represented by relative demand coefficients, the implicit stochastic model provides planners with the optimal value of reservoir yield. The lack of strong and reliable economic criteria, which is common in developing countries, is replaced in this approach by optimizing the reliability of satisfying water demand from the reservoir. A three-level algorithm is proposed for the reservoir yield computation. At the second level, computation of the seasonal reservoir operating rules is presented. The approach use for deriving the reservoir operating rules is based on the nonlinear unconstrained multivariable search method. The third level is used for estimating the single multipurpose reservoir yield. The Fibonacci search procedure is used for the optimization of the reservoir yield at this level. The model is used in reservoir analysis for the water resources master plan of the Republic of Serbia, Yugoslavia. In this case, 49 reservoirs were analyzed. (Author's abstract)
W88-04596

RIVER FLOW MODELLING AND FORECASTING.
For primary bibliographic entry see Field 2E.
W88-04686

DETERMINISTIC CATCHMENT MODELLING,
Lancaster Univ. (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2A.
W88-04687

TIME-SERIES METHODS AND RECURSIVE ESTIMATION IN HYDROLOGICAL SYSTEMS ANALYSIS,
Lancaster Univ. (England). Dept. of Environmental Sciences.
P. C. Young.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 129-180, 10 fig, 2 tab, 43 ref.

Descriptors: *Hydrologic systems, *Time series analysis, *Model studies, *Mathematical studies, Systems analysis, Stochastic models, Hydrological models, Flow forecasting, Mathematical analysis, Mathematical studies.

Hydrological system models are considered within a stochastic setting with an explanation of treating model calibration as a problem of time-series analysis, whereby time-series techniques, such as recursive estimation, can be used in their identification, estimation and validation. In this way, such models can provide a natural vehicle for real-time flow forecasting and, through the recursive approach to estimation, result in continuous updating of model parameters, with the possibility of more advanced self-adapting forecasting procedures. Equations are given for first-order linear models as well as more complicated models which may include finite-difference approximations. Time-series analysis is concerned with the statistical investigation and modelling of data that are uncertain and arranged in some sort of temporal order. Such analysis involves the investigation of assumed causal relationships as, for example, between rainfall and runoff time-series for a catchment. Stochastic effects can be lumped together in a single variable in the model equations to obtain a sequentially updated solution. In practical terms, it is most useful to utilize recursive algorithms. Effects of various applications are discussed, along with consideration of specific models and an indication of how recursive methods of time-series analysis can be applied to flow modelling and forecasting. (See also W88-04686) (Bicht-PTT)
W88-04691

INCREASING THE ECONOMIC EFFICIENCY AND AFFORDABILITY OF STORM DRAINAGE PROJECTS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
H. C. Cochrane, and P. C. Huszar.
Available from the National Technical Information Service, Springfield, VA. 22161. Completion Report No. 126, September 1983. 38 p, 5 fig, 2 tab, 21 ref.

Descriptors: *Urban runoff, *Storm runoff, *Economic aspects, *Water resources management, *Project planning, Costs, Cost-benefit analysis, Hydraulic structures, Flooding, Management planning.

This report attempts to explain several improvements to the conventional analysis of storm drainage projects. The intent of these improvements is to increase the efficiency of public expenditures on storm drainage. The improvements proposed are well grounded in the economic theory of cost-benefit analysis and are not radical ideas, but simply represent corrections of deficiencies in many present evaluations. Storm drainage costs must be affordable, but also yield the largest possible surplus of benefits over costs. Four improvements to the conventional cost-benefit analysis of storm drainage projects are presented here. These improvements refine the conventional analysis such that projects emerging from the analysis with a recommendation to adopt are more affordable and efficient. The improvements relate to the: (1) level of protection provided by the project, (2) timing of project implementation, (3) disaggregation of a drainage into reaches and interdependence, and (4) mixing of structural (e.g. dams, levees, channelization) and nonstructural (e.g., land use planning, insurance, warning systems) adjustments to flooding. These improvements should be useful to: (1) city managers and city councils who must decide on the appropriateness and funding levels of proposed drainage projects, (2) city engineers and planners who must determine the nature of stormwater flooding hazards and develop measures for dealing with the problems that exist, (3) city staff or outside consultants charged with formulating and evaluating alternative stormwater management plans, and (4) concerned citizens and public interest groups who wish to participate in the process of selecting the best solution for their community. (Lantz-PTT)
W88-04708

RISK ASSESSMENT FOR THE PROTECTION FROM AND THE PREVENTION OF GROUNDWATER CONTAMINATION,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 5G.
W88-04750

RELIABILITY OF RESERVOIR OPERATION UNDER HYDROLOGIC UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-04766

STATE WATER PLANNING -- THE MULTIPLE CHOICE APPROACH,
Nebraska Univ.-Lincoln. Conservation and Survey Div.
R. D. Kuzelka.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 481-488, 3 append.

Descriptors: *Groundwater management, *Management planning, *Water policy, *Water law, *Nebraska, Interagency cooperation, Local governments, Project planning, Resource management, Legal aspects, Public participation, Legislation.

In 1978 the Nebraska Legislature directed the Nebraska Natural Resources Commission (NRC), in cooperation with other state agencies, to undertake a state water planning and review process. This program was to replace previous state water planning efforts which were directed toward a final State Water Plan. The program embodies five activities which were intended to provide a tool for managing state water planning and review. To data, the major activity in the program has been the development of policy issue studies. Each study is prepared by a technical task force. Then, it is presented to the NRC, which holds a public hearing on the study. It is also reviewed by a specially apponted 11-member public advisory board (PAB). A key element in each study is a list of policy alternatives for possible legistlation related to the policy issue which is addressed by the study. The NRC and PAB react to these alternatives and make recommendations to the governor and Nebraska Legislature on the alternatives. Twelve policy issue studies are now complete. More than 100 policy alternatives have been suggested. Legislation has been proposed and enacted which relates to some of the alternatives. The alternatives as presented in the 12 studies, the reactions and recommendations by the NRC and PAB, and the actions by the Nebraska Legislature are analyzed. This multiple choice approach of state water planning is compared to the more conventional state water plan approach. (See also W88-04894) (Author's abstract)
W88-04926

6B. Evaluation Process

TURNKEY APPROACH AT CALAVERAS SAVES TIME AND MONEY,
Atkinson (Gay F.) Construction Co., South San Francisco, CA.
For primary bibliographic entry see Field 8A.
W88-04539

PROCEEDINGS OF THE SEVENTEENTH MISSISSIPPI RESOURCES CONFERENCE.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116769. Price codes: A06 in paper copy, A01 in microfiche. March 25-27, 1987, Jackson, MS. 1987. 110 p. Edited by Elizabeth J. Hawkins.

Descriptors: *Water law, *Water resources development, *Conferences, *Mississippi, Water management, Water supply, Water quality, Information exchange, Research needs, Water demand.

The papers in this conference proceedings cover institutional issues of water management, water quantity and water quality management, basic research, and water supply problems. The program and a list of conference participants are included. (See W88-04665 thru W88-04685) (Lantz-PTT)
W88-04665

FORECASTING AND WARNING SYSTEM OF THE 'RIJKSWATERSTAAT' FOR THE RIVER RHINE,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 2E.
W88-04695

PROCEEDINGS, SEVENTEENTH MISSISSIPPI WATER RESOURCES CONFERENCE, 25-26 MARCH 1987, JACKSON, MISSISSIPPI.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116769/AS. Price codes: A06 in paper copy, A01 in microfiche. Proceedings Report, 1987. 110 p. Edited by E. J. Hawkins. Contract No. G1234.

Descriptors: *Water management, *Data storage, *Data retrieval, *Model studies, *Groundwater movement, Water law, Computer models, Mathematical models, Hydraulic models, Surface water, Economic impact, Waterways, Irrigation, Flooding.

The proceedings of the seventeenth Mississippi water resources conference are compiled. In this conference, papers focused on specific problems, systems, and methods applicable to water management in the state and the region. Twenty-one papers by separate authors addressed information/data management, assessed impacts of the 1986 drought, presented modeling techniques for various surface and groundwater problems, presented water quality studies, reviewed alternative sources of supply, and discussed water allocation. (Hawkins-MI St. U.)
W88-04749

RECHARGE WITH PLAYA LAKE WATER AND FILTER UNDERDRAINS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W88-04917

SECONDARY RECOVERY OF CAPILLARY WATER,
High Plains Underground Water Conservation District No. 1, Lubbock, TX.
For primary bibliographic entry see Field 4B.
W88-04928

SLATON AND IDALOU FIELD TESTS IN THE SECONDARY RECOVERY OF WATER FROM THE OGALLALA,
Rauschuber (Donald G.) and Associates, Inc., Manchaca, TX.
For primary bibliographic entry see Field 4B.
W88-04929

SCIENTIFIC AND ECONOMIC RESEARCH IN SUPPORT OF THE INVESTIGATION OF SECONDARY RECOVERY OF GROUND WATER,
Texas Tech Univ., Lubbock. Water Resources Center.
For primary bibliographic entry see Field 4B.
W88-04930

USE OF SURFACTANTS TO PROMOTE DRAINAGE WITHIN A DEWATERED ZONE,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 4B.
W88-04931

WATER SUPPLY, SANITATION AND HEALTH EDUCATION PROGRAMMES IN DEVELOPING COUNTRIES: PROBLEMS OF EVALUATION,

Linkoeping Univ. (Sweden). Dept. of Pediatrics.
U. Lindskog, P. Lindskog, and S. Wall.
Scandanavian Journal of Social Medicine, Vol. 15, No. 3, p 123-130, 1987. 1 tab, 30 ref. Swedish Agency for Research Cooperation with Developing Countries grant.

Descriptors: *Data acquisition, *Water supply, *Education, *Public health, *Developing countries, *Sanitation, *Evaluation, Water pollution effects, Design criteria, Social aspects, Diseases.

Fifteen intervention studies concerning the impact of a water supply and/or sanitation project on public health were reviewed to discover if the design and method of data collection used in an evaluation have any systematic effects on the results. The reviewed studies were of several types: prospective cohort, retrospective cohort, and case-control. Some of the problems of the study methods were as follows: lack of adequate control, one-to-one comparison, confounding variables, inadequate definitions of health indicators, failure to analyze by age, failure to record usage of facilities, too-short length of study, too-long recall periods concerning symptoms and events, and failure to distinguish between signals and background noise. The case-control method has several advantages over cohort studies. Case-control studies do not require working with the same population before and after an intervention, and a much smaller study population is possible. However, case-control studies are limited to chosen health indicators and are not useful in a complex situation. For a cohort design, prospective before-after studies with intervention and comparison groups from several communities should be chosen. With weaker designs it is not possible to standardize for confounding factors. (Cassar-PTT)
W88-05072

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER DEVELOPMENT FUNDING,

World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
L. Laugeri.
Water Resources Journal, No. 153, p 23-24, June 1987. 2 fig.

Descriptors: *Water resources development, *Financing, Economic aspects, Water demand, Water supply, Sanitation, Costs, Institutional constants.

Revolving funds, which consist of fixed amounts initially invested, and then progressively increased by their periodic returns, can contribute efficiently to the expansion of domestic water supply and sanitation. This financing system is particularly well adapted to the characteristics of the water market, since the increase in funds keeps pace with the growth of demand, as is currently being demonstrated in Brazil and other countries. While the technical soundness of these accounting and planning methods is beyond question, their ability to facilitate expansion varies considerably from one country to another, and there may be specific constraints related to high service costs, slow demand growth, and inadequacy of the institutional framework. Since the demand for water (and sanitation) is assumed to increase continuously as a result of growth of population and the individual's propensity to consume more, planners are faced with a commitment to fulfill a objective: water supply and sanitation services should expand in order to achieve total coverage at a given point of time, and thereafter they should continue this expansion in order to maintain total coverage over an indefinite period. This summary of constraints related to high cost, slow growth and inadequate institutions suggests that revolving funds may not always be the ultimate answer to extending water supply (and sanitation) services to all. Where they are feasible, however, they have the merit of forcing the sector into a disciplined and reliable organizational framework. While they do not generate resources, they can act as catalysts and long-term regulators. The entire water supply (and sanitation) sector can rely on their proceeds, industry can expand, labor can be hired, foreign currencies can be saved and increasing health benefits can be expected. So it is always advisable to evaluate the intersectorial impact of revolving funds, and their benefits to the economy as a whole. It is also essential for governments to commit themselves to ensuring their continuous financial performance, and in particular for all surplus income generated in water supply to be earmarked so as to ensure that revolving funds do indeed revolve. (Lantz-PTT)
W88-04519

IRRIGATION WATER CHARGE IN CHINA,

University of Agricultural Engineering, Beijing (China). Dept. of Irrigation and Drainage.
X. Guohua.
Water Resources Journal, No. 153, p 68-72, June 1987. 2 tab.

Descriptors: *Irrigation water, *China, *Water rates, *Economic aspects, Crops, Water use, Water demand.

China has a long history of irrigation. The famous Dujiangyan irrigation works, for example, has been operating continuously for more than 22.3 centuries and is still efficiently irrigating 587,000 ha of land. The main irrigated crops are rice, wheat, maize, and cotton. Rice is the dominant crop in southern China where the climate is warm and humid. Wheat, maize and cotton are the main crops in north China where the climate is semi-arid to semi-humid, and water resources are not abundant. Actual water use by different farmers is not measured: instead, it is assumed that each irrigation concerns X cubic meter of water. However, the water delivered by the main canals is actually measured with a device and the total amount of water allocated to a village is estimated by persons rich in experience. As far as the total sum of water volumes is concerned, all use by villagers must meet the amount measured at the upper level. This means that although the amount of water is not actually measured at field level, the amount of water for a village is measured with reasonable accuracy so that any errors in measurement occur within the confines of the village boundary. The forms and rates of water charges vary with different projects under different conditions. The irrigation water charge per ha in the rice growing Dujiangyan scheme, for example, ranged from 37.5 to 75 kg of husked rice plus half a day of labor for annual repairs through the 1940s to the beginning of 1980s, the rate varying for land of differing quality. In 1979, China started her great economic reforms and in 1981, the basis for water charges was changed. At the beginning of that year, the former Ministry of Water Conservation and Hydro-Electric Power (MWCHP), conducted a nation-wide investigation of water charges. From the end of 1981 till the summer of 1985, MWCHP held many special conferences to discuss and study the water charge issue and finally, in July 1985, the State Council issued 'The principles of determination, calculation, collection and use of water charge of water conservancy works'. The State Council announced that: (1) In general, the water charge should be used on the amount of water used; and (2) For agricultural use, a combined system should be used to assess the water charge - part of it based on the area of irrigated land (the basic charge) and the other part on the amount of water used. (Lantz-PTT)
W88-04522

ARE LARGE SCHEMES WORTH THE COST,

S. Sharma.
Water Resources Journal, No. 153, p 74-75, June 1987.

Descriptors: *Irrigation programs, *Economic aspects, *Costs, *Water conservation, Crop yield, Agriculture, Financing.

Irrigation, long regarded as part of the solution to world hunger, has, in many areas become part of the problem, as poor irrigation turns farmland into salty areas and hastens desertification. In most parts of Africa, Asia, North and South America, for every hectare of newly irrigated land, another hectare of irrigated land goes out of production. In India, where canal irrigation began in the Mughal period, the problem of waterlogging due to canal irrigation has been known for centuries. Though major and medium-sized irrigation projects were considered instrumental in increasing crop yields in the past, the present alarming trend of waterlogging may cloud all these achievements. While irrigated land should yield at least 4-5 tons of grain/ha, the actual yields are only 1.7 tons on average. The losses of the major and medium-sized irrigation projects during 1979-1982 amounted to $974 million. On average, the states lost $367.7 million in 1981-82, which rose to $469 million in 1983, and subsequent losses during the current Plan are expected to be more than $649 million a year. While cost is one factor, a failure to achieve targets is another. In the 23 years up to 1979, the increase in irrigated areas should have been 58.6 million ha whereas the actual increase was just 27.9 million ha. Had the potential been fully realized, the yields were projected to increase to 121 million tons, yet the actual yields were a mere 67 million tons. The main strategy in the Seventh Five-Year Plan of the UN Planning Commission, is to increase productivity in the irrigated areas, which is presently low. The Seventh Plan document indicates that minor irrigation schemes provide a good source of irrigation in several chronically drought-affected areas, and being labor-intensive, they provide excellent opportunities for rural employment. However, the Planning Commission has only allocated $2,276 million for the minor irrigation sector during the Seventh Plan in contrast to the $9,379 million for the major and medium projects. (Lantz-PTT)
W88-04523

TURNKEY APPROACH AT CALAVERAS SAVES TIME AND MONEY,

Atkinson (Gay F.) Construction Co., South San Francisco, CA.
For primary bibliographic entry see Field 8A.
W88-04539

RIGHT TO USE VERSUS THE RIGHT TO SELL: SPILLOVER EFFECTS AND CONSTRAINTS ON THE WATER RIGHTS OF IRRIGATION ORGANIZATION MEMBERS,

National Center for Atmospheric Research, Boulder, CO. Environmental and Societal Impacts Group.
K. A. Miller.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2166-2174, December 1987. 2 fig, 2 tab, 19 ref.

Descriptors: *Water rights, *Irrigation, *Water use, *Water demand, *Costs, Competing use, Water transfer, Optimization, Regression analysis, Statistical studies, Economic aspects.

Irrigation organizations often place restrictions on individually arranged water sales to outside parties. It is shown that these restrictions may be consistent with efficient water use and transfers in cases where individually arranged transfer would impose detrimental spillover effects on other members of the organization. Joint optimization in the presence of spillover effects implies that organization level water trading activity will increase with an increasing market price of water and will decrease with an increase in the internal net marginal value of water. Regression analysis and other empirical evidence are found to be consistent with these implications. These results suggest that irrigation organizations engage in efficient water transfer on behalf of their members and that locally imposed restrictions on individual water transfers are not necessarily economically inefficient. (Author's abstract)
W88-04597

FINANCING WATER AND SEWER EXTENSIONS IN URBAN GROWTH AREAS: CURRENT PRACTICES AND POLICY ALTERNATIVES,

North Carolina Univ., Chapel Hill. Center for Urban and Regional Studies.
R. J. Burby, D. H. Moreau, and E. J. Kaiser.

Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128145/AS. Price codes: A06 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, UNC-WRRI Report 232, Sept. 1987. 169 p, 18 fig, 5 tab, 154 ref. Contract No. USGS 14-08-0001-G1134.

Descriptors: *Financing, *Capital costs, *Sewer, *Expansion, *Planning, Budgeting growth, Economic growth, Southeast US, Local governments, Urban areas, Water pollution control, State governments.

Increasing population and rapid economic development in the Southeast are straining the financial resources of local governments charged with providing water and sewer services to accommodate growth. This study of utility extension policies and financing practices in nine states (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia) indicates that in many cases utilities are turning to the private sector to pay capital costs of extending water and sewer lines. That is in keeping with a fundamental principle of public finance (beneficiaries of services should pay the costs associated with those services), but it may be inequitable in some circumstances. Analysis of facility expansion decision making by public utilities indicates that if demand management techniques are used more widely, utilities will be able to defer the need for costly capital investment in facility expansion. Also by increasing the sophistication of capital planning and more frequently coordinating water and sewer extensions with local governments' land use and growth management plans, utilities will improve the efficiency of their operations and at the same time provide a defensible basis for imposing capital facility charges on the private sector. State governments can foster improvements in utility service extension and financing practices by initiating capacity-building programs designed to inform utility directors and their staffs of new planning an budgeting techniques. It is recommended that state governments take steps to discourage the use of special districts to provide water and sewer services, since such districts tend to lag behind city and county agencies in adapting sophisticated planning and budgeting techniques. (Lambert-UNC-WRRI)
W88-04746

FEDERAL TAX CODE OPPORTUNITIES TO MAINTAIN WETLANDS,
Nature Conservancy, Arlington, VA.
For primary bibliographic entry see Field 6E.
W88-04968

TAX DISINCENTIVES AND OTHER FEDERAL PROGRAMS DISCOURAGING PRESERVATION OF WETLANDS,
Environmental Law Inst., Washington, DC.
For primary bibliographic entry see Field 6E.
W88-04969

6D. Water Demand

POLITICS OF GROUND-WATER MANAGEMENT REFORM IN OKLAHOMA,
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 6E.
W88-04487

VIET NAM PLANS WATER SUPPLY SCHEMES FOR 65 MILLION,
For primary bibliographic entry see Field 5F.
W88-04554

WATER ALLOCATION: BENEVOLENT CZAR OR CRYSTAL PITCHER APPROACH,
Arkansas Water Resources Research Center, Fayetteville.
L. E. Mack, and A. W. Peralta.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 1-4, 9 ref.

Descriptors: *Water law, *Water use, *Water allocation, *Regulations, *Water rights, *Arkansas, Legislation, Groundwater management, Resources allocation, Surface water, Riparian rights, Riparian waters, Legal aspects, Water management.

Arkansas is a riparian rights doctrine state with reasonable use of both ground and surface water. The state is presently empowered to allocate water in times of shortage, but has utilized this power little as yet. During the last legislative session, a comprehensive water code mandating allocation of both ground and surface waters failed to pass. A new water code is expected to be introduced and may incorporate major elements of the prior appropriation doctrine with state allocation of water. The creation of informed united user districts where needed is an attractive alternative for Arkansas. Such districts are not at variance with existing water law, although legislative action would be required for their creation. Substate level autonomous districts with state agency oversight and coordination combines the best of local and state water management. The comprehensive allocation program suggested by some is not appropriate for use in Arkansas for a number of reasons: (1) Attempts to control water use from the top down is fundamentally unsound. History has proven that such control is impractical and all but impossible to enforce; (2) Allocation and permitting requirements for the waters of the state is a very different proposition when water is scarce, as in the intermountain west than it would be for Arkansas; (3) Arkansas is water-rich but economically less prosperous; (4) Allocation is out of tune with nature. When there is plenty of water, why worry about permits; (5) Tourism is important to Arkansas. Instream values are more difficult to protect when water users are forced to 'use' water or 'lose' the right to use it in the future; (6) Water allocation is needed only during times of drought when most everyone needs it at the same time. The burden on the regulatory agency would be over whelming and there are not enough 'water cops'; and (7) Before making sweeping changes in the basic water rights system, legislators should look at less radical alternatives. (See also W88-04665) (Lantz-PTT)
W88-04666

WATER ALLOCATION IN KENTUCKY: LEGAL AND INSTITUTIONAL FRAMEWORKS,
Kentucky Natural Resources and Environmental Protection Cabinet, Frankfurt. Div. of Water.
For primary bibliographic entry see Field 6E.
W88-04667

DEVELOPMENT OF A COMPUTERIZED WATER BALANCE PROGRAM FOR THE EASTERN ARKANSAS REGION COMPREHENSIVE WATER SUPPLY STUDY,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. D. Martin.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 9-12, 4 fig, 2 tab, 2 ref.

Descriptors: *Computer programs, *Hydrologic budget, *Water supply, *Water use, *Arkansas, Computers, Water resources development, Water management, Competing use, Groundwater management.

A basic tool for analysis of the existing and future conditions of the Eastern Arkansas Region is the preparation of a water balance. A computerized water balance program was developed to aid in meeting the schedule and to allow flexibility for determination of alternative future conditions. The development of this program is described here. The final product was a FORTRAN 77 code about 500 lines in length, developed on a HARRIS 500 computer and utilizing the HARRIS data base management system, INFO, to manipulate the input files. For the Eastern Arkansas study the water balance program was used to model conditions at the end of each decade, 1980 to 2030. Demand files were based on predictions of increases in population, livestock herds, industrial activity, crop irrigation, and use for fish and wildlife. Thermo-electric power generation and commercial fishery activity are assumed constant. With usage rates held constant, the demand files were updated for each decade by use of a growth multiplier for each category and, in the case of irrigation, each crop type. This greatly facilitated the update process. Supply files were updated based on the previous decades results for groundwater. Surface water was assumed to renew at the same rate each year. The use rates also could be easily changed to reflect conservation measures or legislative restrictions on groundwater withdrawal. The water balance program was used to evaluate several scenarios for future water consumption. (Lantz-PTT)
W88-04668

MOVING TOWARD ALABAMA LEGISLATION FOR WATER RESOURCES MANAGEMENT,
Auburn Univ., AL. Water Resources Research Inst.
For primary bibliographic entry see Field 6E.
W88-04670

WATER MANAGEMENT DISTRICT,
Delta Council, Stoneville, MS.
For primary bibliographic entry see Field 4B.
W88-04673

COUNTY-LEVEL PROJECTIONS FOR INDUSTRIAL WATER DEMAND IN MISSISSIPPI,
University of Southern Mississippi, Hattiesburg. Dept. of Economics.
E. Nissan, and D. C. Williams.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-116777/AS. Price codes: A05 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report G1234-02, July 1987. 77 p, 10 tab, 12 ref, append. Contract No. 14-08-0001-G1234. Project No. USGS G1234-02.

Descriptors: *Mississippi, *Water demand, *Water use, *Industrial water, Water management, Planning, Projection, Future planning, Industrial categories.

The objective of this project is to provide an assessment and projection of industrial water intake at the county level in Mississippi. Projections are made for the years 1990, 1995, 2000, and 2010. The estimates of industrial water intake by county are based on the relationship between manufacturing employment and water intake derived from national data published in 1986 by the Bureau of Census. National water intake per worker data were applied to the number of workers in the county in SIC industries to obtain an industrial water intake profile for each county based on 1984 employment. Projections for water intake were made based on projected employment. On the basis of county water intakes, estimates for the aggregate state industrial water intake were made. Furthermore, average water intake per employee for the major industry groups SIC 20 - SIC 39 were generated for the State of Mississippi. These estimates differ somewhat from the national averages. (Williams-U. SO. MS.)
W88-04753

6E. Water Law and Institutions

POLITICS OF GROUND-WATER MANAGEMENT REFORM IN OKLAHOMA,
Iowa Univ., Iowa City. Dept. of Geography.
R. S. Roberts, and S. L. Gros.
Ground Water GRWAAR, Vol. 25, No. 5, p 535-544, September-October 1987. 2 fig, 42 ref.

Descriptors: *Groundwater management, *Oklahoma, *Political aspects, *Water law, Water supply, Economic aspects, Water use, Competing water use, Costs, Water management.

Examination of the politics of groundwater management reform in Oklahoma shows that geo-

graphic distribution of water supplies and uses significantly modifies the distribution of costs and benefits of reform among political constituencies. Effective restrictions on groundwater withdrawal would raise large and immediate threats to irrigators and farm communities dependent on irrigation in western Oklahoma. Municipal and industrial water users, concentrated in eastern Oklahoma and reliant on more plentiful surface-water supplies, would receive more diffuse, longer-range benefits to management reform. These effects have significant implications for the politics of groundwater management. The results of the analysis suggest that approaches taken to groundwater management reform in Oklahoma, and the other eastern Ogallala states, may be more effective and realistic than might initially be thought. Oklahoma's present groundwater law, adopted in 1973, is based on a utilization policy of planned depletion and represents a major change in direction entailing significant implementation costs. Agricultural interests, seeking to protect their irrigation rights, were influential in both the adoption and implementation processes. Considering the problems encountered, the immediate outlook for effective state management of groundwater remains unfavorable. Future prospects, however, are more favorable. Oklahoma has developed an institutional structure capable of responding to changing priorities and needs of irrigators. This long-run approach to groundwater management matches the interests of the most relevant political constituency and may prove to be the most effective strategy. (Author's abstract)
W88-04487

RIGHT TO USE VERSUS THE RIGHT TO SELL: SPILLOVER EFFECTS AND CONSTRAINTS ON THE WATER RIGHTS OF IRRIGATION ORGANIZATION MEMBERS,
National Center for Atmospheric Research, Boulder, CO. Environmental and Societal Impacts Group.
For primary bibliographic entry see Field 6C.
W88-04597

WATER ALLOCATION: BENEVOLENT CZAR OR CRYSTAL PITCHER APPROACH,
Arkansas Water Resources Research Center, Fayetteville.
For primary bibliographic entry see Field 6D.
W88-04666

WATER ALLOCATION IN KENTUCKY: LEGAL AND INSTITUTIONAL FRAMEWORKS,
Kentucky Natural Resources and Environmental Protection Cabinet, Frankfurt. Div. of Water.
V. D. Lee.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 5-7, 1 tab.

Descriptors: *Water allocation, *Water law, *Kentucky, *Legal aspects, *Regulations, Common law, Legislation, Riparian rights, Groundwater management, Water management, Surface water, Permits, Water use, Riparian waters.

Water rights in Kentucky may be characterized as a complicated mixture of statutory and common law rights. Despite some fundamental problems, superimposing statutory rights on older common law rules has served to make water rights available to more users than under common law exclusively. Common law rights in Kentucky have their foundation in the Riparian Doctrine: a collection of judicially-developed principles used by courts in deciding water use cases. The basic concept of the Riparian Doctrine is that water rights are directly linked to ownership of land bordering a natural watercourse. Riparian rights are not absolute. Rather, they are correlative in nature: requiring each riparian land owner to consider the needs of other riparian proprietors. In 1954, after years of confusion, the Kentucky legislature rejected the more restrictive doctrine of Natural Flow by officially adopting the Reasonable Use rule (KY Acts, Ch. 247 Sec. 2). The Act provided that the use of water by a riparian owner for domestic purposes would have priority over other uses. This Act was repealed in 1966 (KY Acts Ch. 23 Sec. 39), and replaced by KRS 151, a broadly-based water resources statute, administered by the Kentucky Natural Resources and Environmental Protection Cabinet. The new statute regulates water use, dams, water resources planning, construction for flood control and water resources development. While no specific 'Reasonable Use' language is incorporated, the intent is clear. Regulation is achieved by requiring permits of anyone desiring to withdrawn, transfer, or divert public water except for certain exempted uses. Domestic and agricultural uses are exempted by statute (KRS 151.140) as are steam generating plants whose retail rates are regulated by the Public Service Commission and the use of water injected underground in conjunction with operations for the production of oil or gas. (Lantz-PTT)
W88-04667

MOVING TOWARD ALABAMA LEGISLATION FOR WATER RESOURCES MANAGEMENT,
Auburn Univ., AL. Water Resources Research Inst.
J. C. Warman.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 19-22, 5 ref, 2 append.

Descriptors: *Alabama, *Legislation, *Water law, *Water resources management, Water management, Groundwater management, Public relations, Water use, Legal aspects, Regulations, Water rights, Management planning.

As a water-rich state Alabama historically has enjoyed the luxury of an abundance of both surface water and groundwater. Little thought was given to management except for the protection of human health. In recent times, concern for environmental protection led to rapidly broadening regulations over discharges into the waters. Early programs were designed for improvement in waste treatment technology. Later (1965 and on), emphasis shifted to development of process changes that would enable industry to produce their products with significant reduction in effluent load. In about those same years much effort was devoted to comprehensive planning for land and water resources development. Review of these and related efforts in many states shows a production of state plans that were public relations documents rather than actual plans. Over the past several months the Alabama Farm Bureau Federation has responded to the interests and concerns of its membership to explore the feasibility and desirability of water resources management law in Alabama. While a case can be made for the desirability of a law covering the total water resources of the state, the groundwater problems were perceived by the Federation as more pressing than surface water problems. This Alabama Farm Bureau Federation draft bill provides a time-limited permit system for use of groundwater, protects an aquifer from overdraft, provides that the right granted by a permit may be conveyed, bequeathed or inherited, and among other points provides that a permit may be revoked or modified. The draft bill declares that all groundwater is among the basic resources and natural legacies of the State and therefore subject to regulation under the police powers of the State. Appendices to this paper discuss Alabama's water resources policy and water law and administration in Alabama. (See also W88-04665) (Lantz-PTT)
W88-04670

WATER MANAGEMENT DISTRICT,
Delta Council, Stoneville, MS.
For primary bibliographic entry see Field 4B.
W88-04673

REGULATIONS FOR IMPLEMENTING THE PROCEDURAL PROVISIONS OF THE NATIONAL ENVIRONMENTAL POLICY ACT.
Council on Environmental Quality, Washington, DC.
Reprint, 40 CFR Parts 1500-1508, July 1, 1986. 45 p.

Descriptors: *Regulations, *National Environmental Policy Act, Environmental Quality Improvement Act, Clean Air Act, Environmental protection, Environmental policy.

Contained in this pamphlet are: (1) The National Environmental Policy Act of 1969, as amended; (2) The Environmental Quality Improvement Act of 1970; (3) The Clean Air Act; (4) Executive Order 11514, as Amended by Executive Order 11991; and (5) Regulations for Implementing the provisions of these acts. (Lantz-PTT)
W88-04705

UPWELLING ZONES OF THE ATLANTICO-IBERO-AFRICAN REGION: THE LEGAL FRAMEWORK AS A FACTOR IN OCEAN RESOURCES MANAGEMENT,
For primary bibliographic entry see Field 2L.
W88-04721

GROUNDWATER MANAGEMENT UNDER THE APPROPRIATION DOCTRINE, PART II,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
D. Ralston, and E. J. Bruhl.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-234563/AS. Price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, June 1987. 26 p, 4 fig, 12 ref.

Descriptors: *Groundwater management, *Western States, *Prior appropriation doctrine, Legal aspects, Institutional constraints, Regional development, Resources management.

States that administer groundwater under the prior appropriation doctine experience similar management problems. A comparison of management activities in Washington, Idaho, Oregon, Montana, Arizona, Utah, Colorado, and New Mexico indicates a common pattern of management development in four stages. These stages are initial development, local stress, regional stress, and controlled use. Montana is the best example of groundwater management under the stage of initial development. Portions of Idaho, Oregon and Washington illustrate the management of groundwater classified as local stress. The Snake River Basin of Idaho and the Umatilla Basin of Oregon are approaching levels of regional management difficulty which typify regional stage stress. Arizona defines the fourth stage of development, controlled use. Utah's management of groundwater is characteristic of both initial development and regional stress. Groundwater development has been curtailed in Utah by preventing new appropriations. Both Colorado and New Mexico utilize a controlled mining approach to groundwater management which is indicative of controlled use management. Colorado manages 'tributary' groundwaters in conjunction with surface water in a regional stress management setting. Groundwater management in New Mexico is dominated by the discretionary authority of the State Engineer. It is important to recognize that the Pacific Northwest states are attempting to administer groundwater as a renewable resource. A non-renewable approach to groundwater management is utilized by Colorado and New Mexico. The mining of groundwater in these two states is centrally controlled in a manner which has been labeled as controlled use. This contrasts sharply with the renewable resource approach utilized in Arizona's controlled use management activities. This illustrates that controlled use is best defined by administrative control of resource use as opposed to management goals and objectives. (USGS)
W88-04761

FEDERAL COOPERATION IN RECHARGE AND REPLENISHMENT,
Bureau of Reclamation, Washington, DC.
For primary bibliographic entry see Field 4B.
W88-04913

LEGAL ASPECTS OF GROUNDWATER MANAGEMENT IN THE OGALLALA AREA,
McCleskey, Harringer, Brazill and Graf, Lubbock, TX.
D. Graf.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 465-480, 33 ref.

Descriptors: *Groundwater management, *Groundwater depletion, *Water rights, *Water law, *Ogallala Aquifer, Groundwater mining, Regulations, Legal aspects, Water costs, User charges, Water conservation, Colorado, Nebraska, New Mexico, Kansas, Oklahoma, Texas, Legislation.

Comparison of groundwater laws among the Ogallala states reveals widely differing legal theories. Changes in legal regulation continue to increase in each state as perceived scarcity becomes more evident. Colorado has repealed its earlier legislation and replaced it by the Colorado Groundwater Management Act. Oklahoma enacted a new groundwater code in 1972 requiring a permit for all groundwater withdrawals except domestic uses. Nebraska enacted its groundwater management statute in 1975. New Mexico and Kansas both continue to rely on their appropriative-permit statutes which were enacted many years ago. Texas alone still adheres to the rule of absolute ownership of groundwater. The Texas system of groundwater regulation is not statewide, but operates by districts which are imposed only by affirmative vote of the area affected. The arguments for statewide control, as opposed to the regional system, must be reviewed in terms of the accomplishments of the districts and their effectiveness in using local tax dollars. With decreases in groundwater availability, the doctrine of reasonable use will become a part of Texas law. (See also W88-04894) (Geiger-PTT)
W88-04925

STATE WATER PLANNING -- THE MULTIPLE CHOICE APPROACH,
Nebraska Univ.-Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 6A.
W88-04926

OGALLALA AREA OF TEXAS — LOOKING TO THE FUTURE,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 3F.
W88-04927

OVERVIEW OF POLITICAL, SCIENCE AND MANAGEMENT ISSUES IN THE CHESAPEAKE BAY REGION,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
J. A. Mihursky.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 11-15.

Descriptors: *Political aspects, *Technology, *Chesapeake Bay, *Management planning, Legislation, Research priorities, Public participation, Human population.

The political community's current interest in the Chesapeake Bay hinges on a few key legislators in powerful positions. Continuance of cleanup efforts may require: (1) enactment of long-term Chesapeake legislation; (2) election of 'Chesapeake-sensitive' legislators; and (3) development of structural and institutional arrangements. In addition, those efforts must be grounded in the use of science and research; controversial issues remain and can only be resolved with accurate scientific data. Approximately 66% of the nation's population lives on the sea coast or within 50 miles of tidewater. Projections are for 80% to live on or within 50 miles of the sea coast in the near future. The Chesapeake is scheduled to be an integral part of the new Bos-Rich-Folk megalopolis extending from Boston to Richmond-Norfolk by 2020 or sooner. However, population control coupled with wise use of scientific, technological, managerial, and regulatory skills will guarantee an ecologically healthy and economically productive Chesapeake Bay. (See also W88-04934) (Lantz-PTT)
W88-04935

EPA AND THE CHESAPEAKE BAY,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W88-04938

PRESERVATION OF THE CALIFORNIA COAST: TWENTY YEARS OF LEARNING,
California State Coastal Conservancy, Oakland, CA.
J. E. Petrillo.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 189-198.

Descriptors: *Environmental protection, *California, *Regulations, *Coastal zone management, Funding, Public participation, Legislation, Coastal waters, Public policy, Land acquisition.

In the early years of California conservation, with the support of cooperative judicial decisions, the California State Coastal Commission undertook its regulatory function with a vengaence. Projects, from the smallest residential add-on to the most massive commercial developments, were vigorously scrutinized, and the Commission, with the confidence its referendum mandate, did not hesitate to deny permits or require radical changes of those which seemed to threaten the resources of the coast. By 1976, those involved in California's coastal issues knew from experience how coastal regulation could cause bitter conflict and how these conflicts could be resolved. Two important approaches came out of this experience. First, the policies which were to be used in the future to govern coastal development and many coastal activities were described explicitly and refined to the point where their concreteness could assist future regulatory actions. Second was an acknowledgement of the need to acquire critical areas of land along the coast in a systematic way in order to remove them from economic competition or to designate them for uses compatible with the goals set forth in the plan. The Coastal Plan as it was developed relied on the passage of three elements: the Coastal Commission was to be extended; a vigorous program of acquisition of sensitive coastal resource lands and recreational lands was to be funded and carried out; and a special agency to restore and enhance coastal resources was created. The first element was accomplished through direct regulation, the second through Bond Act Funding, and the third through the establishment of the State Coastal Conservancy. The Conservancy has projects which cover the following program areas: (1) resources enhancement; (2) coastal restoration; (3) waterfronts; (4) coastal accessways; (5) nonprofit organization assistance program; (6) reservation of coastal resource sites; and (7) donations and dedications. (See also W88-04934) (Lantz-PTT)
W88-04951

RESOURCE PROTECTION: A DELAWARE PERSPECTIVE,
Delaware State Dept. of Natural Resources and Environmental Control, Dover. Wetlands Section.
W. F. Moyer.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 231-236, 1 fig, 6 ref.

Descriptors: *Resources management, *Environmental protection, *Delaware, *Estuaries, Clean Water Act, Legislation, Regulations, Federal jurisdiction, State jurisdiction, Management planning, Mitigation.

Delaware, through its Inland Bays Study Group and Inland Bays Task Force, has been working to protect the state's three inland estuaries: Rehoboth, Indian River, and Little Assawoman. In response to Task Force recommendations, the Wetlands Section is developing a management strategy for those freshwater wetlands currently regulated under the Clean Water Act 404 program. There remains, however, need for improvement in several areas. Continued wetlands protection will also require: (1) development of an effective wetlands evaluation method; (2) an improved federal enforcement program; and (3) a consistent approach to mitigation by both state and federal agencies. (See also W88-04934) (Lantz-PTT)
W88-04956

PENNSYLVANIA'S WETLANDS: URBANIZATION AND WATERCOURSE MODIFICATION,
Corps of Engineers, Beach Creek, PA. Foster Joseph Sayers Dam.
I. Garskof.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 237-239.

Descriptors: *Pennsylvania, *Wetlands, *Environmental protection, *Regulations, *Environmental effects, Water resources development, Clean Water Act, Dredging, Waste disposal, Streamflow.

Regulation of Pennsylvania's wetlands has been complicated by their diversity and wide geographic distribution. Although figures are not available for wetlands acreage within the Susquehanna River Basin, National Wetlands Inventory calculations indicate approximately 400,000 acres within the entire State. Based upon drainage area and wetlands density, there are probably 200,000-250,000 acres within the Susequehanna River Watershed (including New York). In order to qualify this problem in terms of Wetlands impact investigations conducted since January 1983 were divided into broad categories. These are: filling of wetlands for commercial development - 24 filling of wetlands for residential development - 24%; filling or dredging of wetlands for agricultural development or peat mining - 21%; filling of wetlands to dispose of solid waste - 16%; filling of wetlands for roads or utility construction - 7.4% and stream modifications which alter or destroy wetlands - 3.6%. These figures represent percentages of cases, not total acreage of wetlands impacted. Section 404 of the Clean Water Act only partially protects these wetlands from the effects of urbanization because it regulates neither dredging nor the discharge of waste materials into wetlands when the object is not to create fastland. Because wetlands protection depends ultimately on public support, public education is a priority of the regulatory program. (See also W88-04934) (Lantz-PTT)
W88-04957

IMPACT OF URBANIZATION ON WATERCOURSES IN WASHINGTON, D.C.,
District of Columbia Dept. of Consumer and Regulatory Affairs, Washington.
For primary bibliographic entry see Field 4C.
W88-04958

URBANIZATION, WATER QUALITY AND STORMWATER MANAGEMENT - A MARYLAND PERSPECTIVE,
Maryland Water Resources Administration, Annapolis.
For primary bibliographic entry see Field 5G.
W88-04959

PENNSYLVANIA'S WETLAND REGULATIONS AND THE ARMY CORPS OF ENGINEERS 404 PERMITTING IN PENNSYLVANIA,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Dams and Waterway Management.
K. D. Smith.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 254-256.

Descriptors: *Pennsylvania, *Administrative regulations, *Wetlands, *Permits, Resources management, Legislation, Operating policies, Corps of Engineers, Headwaters.

Under state law, Pennsylvania regulates some types of wetlands and activities more stringently than the federal 404 program administered by the Corps of Engineers. Pennsylvania and the Corps are seeking to achieve greater uniformity among the four Corps Districts in the implementation of the 404 program in the state, and to work out differences via a statewide general permit on isolated and headwaters wetlands to prevent significant cumulative losses. While Pennsylvania would like to assume administration of the 404 program within its boundaries, it currently lacks the resources currently and is pursuing an alternative approach - the joint application - with the Corps and EPA. (See also W88-04934) (Lantz-PTT)
W88-04960

STATE AND FEDERAL PERMITTING,
Corps of Engineers, Baltimore, MD. Baltimore District.
T. Filip.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 257-259.

Descriptors: *Permits, *State jurisdiction, *Federal jurisdiction, *Regulations, Tide lands, Navigable waters, Chesapeake Bay, Wetlands, Elk River, Corps of Engineers.

The U.S. Army Corps of Engineers' program regulating activities in navigable waters and, more recently, all waters of the United States and adjacent wetlands has evolved over more than 80 years in response to statutory, administrative, and judicial changes. The Chesapeake Bay watershed is wholly within the jurisdiction of the U.S. Army Corps of Engineers North Atlantic Division (NAD). Three Corps Districts within NAD share responsibility for permitting activities in the Bay and its tributaries. The Philadelphia District handles a small portion of the Elk River associated with the Chesapeake and Delaware Canal; the Baltimore District regulates activities in the Bay and its tributaries north of the Maryland-Virginia borders and the Norfolk District has the waters of the Bay and its tributaries south of the Maryland-Virginia line. Currently, it effectively regulates tidal wetlands in the Chesapeake Bay watershed, but does not comprehensively cover important non-tidal wetland areas in the upper watershed. (See also W88-04934) (Lantz-PTT)
W88-04961

MARYLAND'S TIDAL WETLAND PROTECTION PROGRAM - PAST, PRESENT AND FUTURE,
Maryland Water Resources Administration, Annapolis.
H. M. Cassell.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 260-268, 4 tab, 3 ref.

Descriptors: *Environmental protection, *Wetlands, *Resources management, *Legislation, *Tide lands, *Chesapeake Bay, Operating policy, Permits, Corps of Engineers, Drainage, Administration, State jurisdiciton, Runoff, Licensing, Management planning.

The Wetlands Division of the Water Resources Department of Natural Resources implements Maryland's tidal wetlands protection efforts. The Wetlands Act of 1970 and subsequent amendments have slowed conversion of tidal wetlands to minimal levels. Maryland's tidal wetlands program is looking at a number of factors which will influence its future direction: (1) more permitting and related responsibilities are likely due to the Corps of Engineers and Environmental Protection Agency the increasing interest in delegation to effective state programs and other regulatory reform; (2) Maryland's Wetland Program would seem to be one of those existing regulatory mechanisms by which certain objectives of the Chesapeake Bay Initiatives might be pursued and aided; (3) Progress toward protectionof non-tidal wetlands and buffer areas abutting tidal wetlands are to be encouraged; (4) the wetland photographs and maps are 15 years old and need to be replaced; (5) since 1978, storm drain systems which discharge directly to tidal waters have required wetlands licenses and updated decision-making criteria and procedures concerning licensing of storm drain systems are being developed and implemented; (6) Although the compilation of annual statistics has aided assessment of the program's cumulative impact upon wetland resources, improved data processing for tracking of licenses and storing case information is planned; and (7) The Department of Natural Resources, Wetlands Division, Department of General Services and Wetlands Administration of the Board of Public Works will review and suggest revisions of compensation fees for filling. The current program is likely to receive additional authority and wil play a role in realizing the objectives of Maryland's Chesapeake Bay Initiatives. (See also W88-04934) (Lantz-PTT)
W88-04962

PERMIT COORDINATION IN VIRGINIA,
Virginia Marine Resources Commission, Newport News. VA.
N. E. Larsen.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 269-272.

Descriptors: *Virginia, *Permits, *Regulations, *Environmental protection, State jurisdiction, Federal jurisdiction, Public policy, Wetlands.

Virginia has worked to streamline its wetlands permit process with federal, state, and local involvement and approvals. Important components are: (1) effective scientific and technical assistance from the Virginia Institute of Marine Science of the College of William and Mary; (2) cooperation from U.S. Army Corps of Engineers; and (3) simple organizational arrangements within state government for regulating shoreline activities. Presently there is no state or local non-tidal wetlands program, although there is a perceived need to know more about these resources and their ecological importance. (See also W88-04934) (Lantz-PTT)
W88-04963

WATER QUALITY CERTIFICATION IN MARYLAND,
Maryland Dept. of Health and Mental Hygiene, Baltimore. Office of Environmental Programs.
M. J. Garreis.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 273-276.

Descriptors: *Water quality control, *Regulations, *Maryland, *Permits, Federal jurisdiction, State jurisdiction, Water quality standards, Clean Water Act, Environmental protection, Corps of Engineers.

States, under Section 401 of the Federal Water Pollution Control Act (Clean Water Act), exercise oversight of federally-permitted projects (e.g., Section 404 wetlands permits) for compliance with state water quality standards. Maryland has refused 401 certification for certain Corps 'nationwide' general permits because of their potentially adverse effects on State Water Quality standards. Maryland's Office of Environmental Programs, which administers Section 401 functions, is seeking to standardize its review process and coordinate with other federal and state agencies having related responsibilities or authorities. (See also W88-04934) (Lantz-PTT)
W88-04964

CHESAPEAKE BAY FOUNDATION'S LAND ACQUISITION AND WETLANDS PROTECTION,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
C. H. Collins.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 277-280.

Descriptors: *Chesapeake Bay, *Land acquisition, *Wetlands, *Environmental protection, Chesapeake Bay Foundation, Publication participation, Institutions, Easements, Land rights, Legal aspects, Economic aspects.

Acquisition of sensitive wetlands in the Chesapeake Basin is an important component of a comprehensive resource conservation and protection program. The Chesapeake Bay Foundation (CBF) and other private and public agencies seek to acquire by fee, easement, or other means sufficient interests in sensitive land areas to protect impairment or loss of valuable natural aspects. For the past 10 years, CBF has operated a modest land conservation program aimed at encouraging private, voluntary efforts to conserve the Bay's scenic shorelines, natural marshes and wetlands, woodlands, and farmlands. To date, the land conservation program has preserved close to 3,000 acres in 13 separate projects. CBF is moving to establish a revolving fund to enable acquisition of important wetlands that later could be resold to state and federal agencies. CBF has decided to retain the role of land conservation catalyst as it expands its land conservation program. As such, emphasis will be placed on working with local, state, and federal organizations to protect important waterfront properties, particularly wetlands, while keeping its long-term ownership to a minimum. Currently, CBF's efforts are focused on initiating watershed protection programs on Bay tributaries. CBF has embarked on a joint conservation easement solicitation and acquisition program in Maryland with the Maryland Environmental Trust (MET). With a conservation easement, a landowner gives up the right to develop his or her property while retaining the right to live on it and maintain its existing use. In return for the value of the donation, the landowner receives income tax and estate tax benefits. This joint project represents the first step in the development of an overall land conservation program on the Bay. Over the long run, CBF hopes to teach private landowners throughout the Bay region about creative land conservation measures that can help protect the living resources of the Chesapeake Bay. (See also W88-04934) (Lantz-PTT)
W88-04965

LOCAL CONTROL OF WETLANDS IMPACTS,
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
A. L. Strong.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 281-288, 20 ref.

Descriptors: *Legal aspects, *Local governments, *Wetlands, *Nonpoint pollution sources, Water quality control, Urban runoff, Environmental protection, State jurisdiction, Regulations, Compensation, Public trust.

Effective local action in managing and protecting wetland areas depends upon an integrated program which deals with urban nonpoint source runoff; rural nonpoint source runoff; and the wetlands themselves. These three elements are covered and the need for state government-level enforcement and back-up is emphasized. The problem of a 'taking' without compensation by regulation is reviewed in the context of preserving natural resources held in 'public trust' by the state and its local governments. (See also W88-04934) (Lantz-PTT)
W88-04966

LOCAL GOVERNMENT APPROACH TO WETLAND PROTECTION,
Harford County Dept. of Planning and Zoning, Bel Air, MD.
R. S. Lynch, and P. de Jong.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 289-297, 3 ref.

Descriptors: *Local government, *Wetlands, *Environmental protection, *Regulations, *Maryland, *Harford County, Buffer strip, Flood plain zoning, Water districts.

A provision in Harford County, Maryland's, zoning regulations known as the 'Natural Resource District' (NRD) is the focus of this paper; an overview of wetland protection strategies is included. The NRD recognizes that effective environmental protection of sensitive natural feature is accomplished by viewing such features as an interconnected system. Major streams in the County were mapped and identified by name in the NRD legislation. The NRD extended stream valley protection to most first and second order tributaries of the major listed streams. The following regulations apply to these streams: (1) the NRD shall be a minimum distance of 150 ft on both sides of the center of line of the stream, or 50 ft beyond the hundred year flood plain, whichever is greater; (2) for tributaries draining a subbasin of 400 acres or more, the NRD shall extend 75 ft on both sides of the stream; (3) a buffer shall be provided within the NRD along the streams and shall be a minimum width of 50 ft plus 4 ft for each 1% increase in slope measured from the water's edge; and (4) trees located within the buffer may be harvested to remove diseased, insect or fire damaged trees, to salvage trees or reduce potential stream blockage due to fallen timber. The intent of these provisions is to provide a defined area along the streams that can be maintained and established as a buffer. This is based on the theory that a natural buffer can be effective in reducing the sediment loading of the streams, thereby protecting plant and animal habitats. (See also W88-04934) (Lantz-PTT)
W88-04967

FEDERAL TAX CODE OPPORTUNITIES TO MAINTAIN WETLANDS,
Nature Conservancy, Arlington, VA.
M. Dennis.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 298-307, 4 ref.

Descriptors: *Taxes, *Federal jurisdiction, *Wetlands, *Environmental protection, Tax codes, Economic aspects, Easements, Land rights, Legal aspects.

The federal tax code allows income and estate tax deductions to taxpayers for gifts of conservation lands, such as wetlands that meet code requirements. In addition to outright gifts of land, gifts of partial interests (easements), 'bargain sales', transfers of 'like-kind' property, and involuntary conversion, benefits offer additional land preservation incentives. Pending proposals to amend the Federal tax code include efforts to increase the allowable deduction for such gifts and would remove current incentives that lead to loss of ecologically valuable land areas. (See also W88-04934) (Lantz-PTT)
W88-04968

TAX DISINCENTIVES AND OTHER FEDERAL PROGRAMS DISCOURAGING PRESERVATION OF WETLANDS,
Environmental Law Inst., Washington, DC.
T. R. Henderson.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 308-315, 3 ref.

Descriptors: *Taxes, *Regulations, *Environmental protection, *Wetlands, Floods, Economic aspects, Insurance, Drainage.

Four types of federal programs inadvertently work at cross purposes with federal wetlands protection programs: tax incentives for land development; technical assistance, loans, and cost-sharing provided by the Department of Agriculture for drainage and 'reclamation'; commodity and price support programs; and insurance and disaster relief. Tax credits and deductions are given for cleaning, draining, or otherwise 'improving' land, as well as for the purchase of farm equipment. The Soil Conservation Service technical assistance and Agricultural Conservation programs, responsible for the drainage of millions of wetland acres in the past, may still be contributing to wetlands drainage. Commodity and price support programs have the potential to encourage the cultivation of wetlands. Finally, insurance and disaster relief payments have unintentionally reduced the cost of developing and farming wetlands and other equally poor farming sites. These policies need to be changed to make them consistent with federal wetlands protection efforts. The difficult task is to devise changes that eliminate the unintended side-effect of wetlands destruction without eliminating the beneficial services provided by the programs. (See also W88-04934) (Lantz-PTT)
W88-04969

MITIGATION AND ITS PROBLEMS,
Fish and Wildlife Service, Annapolis, MD.
G. W. Kinser.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 316-320.

Descriptors: *Mitigation, *Environmental protection, *Legislation, *Wetlands, Regulations, Fish and Wildlife Coordination Act, National Environmental Policy Act, Conservation.

The concept of mitigation and compensation for wetlands loss or impairment grew out of the requirements of the Fish and Wildlife Coordination Act. In 1981, the U.S. Fish and Wildlife Service issued its Mitigation Policy which sets goals for specified resource categories. Mitigation is defined in the National Environmental Policy Act (NEPA) regulations in five parts: (1) avoiding the impact by not taking a certain action or parts of an action; (2) minimizing the impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (5) compensation for the impact by replacing or providing substitute resources or environments. Mitigation banking is a mechanism for achieving compensation for unavoidable impacts and is most applicable to situations involving small wetland losses. Problems occur around the less-than-perfect implementation of mitigation measures to replace all of what has been lost. (See also W88-04934) (Lantz-PTT)
W88-04970

COMPENSATING FOR WETLAND LOSSES IN THE MITIGATION PROCESS,
Environmental Concern, Inc., Michaels, MD.
E. W. Garbisch.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 321-326, 12 ref.

Descriptors: *Compensation, *Wetlands, *Mitigation, *Environmental protection, Permits, Economic aspects, Regulations.

The process of mitigating impacts and losses to wetlands derived from proposed water-dependent projects generally includes the following list of actions in descending order of priority: (1) avoiding the impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree of magnitude of an action and its implementation; (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (5) compensating for the impact by replacing or providing substitute resources or environments. Assuming that items 1-4 have been satisfied for a proposed project and that the regulatory agencies feel the project is in the public's best interest, the proposed compensation for the wetland loss then becomes the deciding factor as to whether mitigation is acceptable and the requisite permits will be issued. Compensation for wetland losses offer potential for both wetland protection and enhancement, though problems can occur in creating or improving wetland areas. Pre-qualification of contractors, permit conditions, advance compensation, and banking, are methods of avoiding such problems in the compensation process. (See also W88-04934) (Lantz-PTT)
W88-04971

VIRGINIA'S WETLAND MITIGATION/COMPENSATION POLICY: ITS EVOLUTION AND CURRENT STATUS,
T. A. Barnard, and W. I. Priest.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 327-333, 8 ref.

Descriptors: *Virginia, *Wetlands, *Mitigation, *Compensation, *Environmental protection, Guidelines, Permits, Public policy, Regulations.

Although there is no formal wetland mitigation policy in Virginia, the state's 'Wetlands Guidelines' do provide a de facto mitigation policy within the coastal permit program. The original Guidelines, written in 1974, list the following as recommended forms of mitigation: (1) avoid the adverse impact altogether; (2) utilize less damaging alternative actions which will achieve the stated goal; (3) reduce the magnitude of the activity; and (4) rehabilitate wetland areas unavoidably damaged by the permitted activity. The 1982 revisions of the 'Wetlands Guidelines' recommended a highly cautious approach to the use of compensation as a form of mitigation. (See also W88-04934) (Lantz-PTT)
W88-04972

VIRGINIA WETLANDS ACT AND THE FUTURE OF WETLANDS MANAGEMENT,
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Ocean and Coastal Law.
N. B. Theberge.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 334-339, 2 ref.

Descriptors: *Virginia, *Wetlands, *Legislation, *Environmental protection, *Economic justification, Virginia Wetlands Act, Management planning, State jurisdiction, Federal jurisdiction, Economic aspects, Costs, Legal aspects, Litigation.

Recent federal court decisions in Virginia place the Virginia Wetlands Act in a position of prominence in state wetlands management. The policy provision and the standards provision of the Act suggest that: (1) economic development has to be 'necessary' in order to disturb any wetlands; (2) 'necessary' economic development should be concentrated in wetlands of lesser ecological significance to the maximum extent practical; (3) 'necessary' economic development may occur in wetlands of primary ecological significant if: (a) use of wetlands of lesser ecological significance is impractical, and (b) disturbance of the ecological system in the wetlands of primary ecological significance is reasonable. The costs of litigation, a well-administered local and state permit process stressing compromise, and the existence of an overlapping, more comprehensive federal wetlands program based on a wealth of well-established legal precedent, tend to deter legal challenges to the Virginia Wetlands Act. As a result, almost a decade and a half has passed since the enactment of the Virginia wetlands statute and not one precedent-setting wetlands case has been heard by the Virginia Supreme Court. Wetlands litigation at the federal level, by comparison, has been rampant. If questions over the value of wetlands, the effectiveness of the federal wetlands program, and the continued involvement of the federal government in wetlands management portend the future, then the Virginia Wetlands Act (and other state wetlands statutes) may find itself scrutinized as never before and possibly standing alone as the sole means of wetlands management in the state. A review of key provisions of the Virginia statute suggests that the Act is more development-oriented than its administrative history indicates. The continued debate over wetlands value, the possibility of diminished federal involvement, and the latent development orientation of the Virginia Wetlands Act raises questions concerning the ability of the state to continue the current level of wetlands protection now enjoyed. (See also W88-04934) (Lantz-PTT)
W88-04973

LAYMAN'S GUIDE TO THE TAKING ISSUE,
Chesapeake Bay Foundation, Inc., Annapolis, MD.

A. Powers.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 340-343.

Descriptors: *Legal aspects, *Wetlands, *Management planning, *Taking, Eminent domain, Compensation, Regulations, Land rights.

Wetland managers need to recognize that wetland regulations may be challenged by landowners on the ground that they constitute a government 'taking' of private property for which compensation is constitutionally required. Courts, when faced with a takings claim, typically look at whether the regulation is related to a legitimate state interest, is fairly applied, and whether the regulation deprives the landowner of all reasonable use of the property. In the event that a court rules that the regulatory action constitutes a 'taking,' the agency should be given the choice of either withdrawing its action or commencing condemnation proceedings, thus shielding the government from forced compensation of landowners. (See also W88-04934) (Lantz-PTT)
W88-04974

COMBINING SCIENCE AND MANAGEMENT: LOOKING AHEAD FOR CHESAPEAKE WETLANDS CONSERVATION. HOW IS THE FEDERAL, STATE, LOCAL PARTNERSHIP WORKING,
Environmental Protection Agency, Philadelphia, PA. Region III.
J. R. Pomponio.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 349-359, 4 ref.

Descriptors: *Wetlands, *Conservation, *Chesapeake Bay, *Political aspects, *Interagency cooperation, Federal jurisdiction, State jurisdiction, Local governments, Research needs, Public policy.

Decisionmaking to protect wetlands involves multiple levels of government and complex interactions among scientists and managers. Scientists need to understand bureaucracy, including the bureaucracy within, and take steps to avoid its pitfalls. The federal/state/local partnership to protect the wetlands in the Chesapeake Bay is working to produce results but leaves room for improvement: (1) Interagency meetings involving the various governmental levels need to have focused goals, pay attention to the larger issues, and attempt more long-range planning; and (2) Interaction coordination efforts should be expanded, roles should be clarified and technical gaps must be filled (especially better identification of the most severe wetland problems in the Bay region). Joint investigations should address the following areas: (1) Basic research to identify linkages between non-tidal fresh wetlands and downstream (including estuarine) functions; (2) Pursuit of a common, or at least interchangeable, computerized data management system, to track wetland-related Bay activities and thereby give some information on cumulative impacts; (3) The completion of community profiles describing the Bay watershed ecosystems; (4) The development or refinement of wetland values assessment techniques; and (5) The development of pre-, in progress, and post-project monitoring studies to fill gaps in predicting project impact and mitigation success. Specific attention should be given to impacts of dam construction and agricultural drainage. (See also W88-04934) (Lantz-PTT)
W88-04976

HOW IS THE FEDERAL, STATE, LOCAL PARTNERSHIP WORKING IN VIRGINIA,
Virginia Deputy Secretary of Resources, Richmond.
R. L. Cook.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 360-362.

Descriptors: *Wetlands, *Virginia, *Interagency cooperation, *Environmental protection, State jurisdiction, Federal jurisdiction, Local governments, Tide Lands, Permits, Management planning, Conservation.

Since the establishment of the Virginia Wetlands Boards System in 1972, cooperation between federal, state and local governments has been instrumental in the success of the tidal wetlands management program. By establishing a coordinated permitting process and a monthly meeting between federal, state and local organizations (federal agencies: Army Corps of Engineers, Fish and Wildlife Service, Environmental Protection Agency, and National Marine Fisheries Service; state agencies: Marine Resources Commission, Game and Inland Fisheries Commission, Council on the Environment, and Virginia Institute of Marine Science), this system has eliminated many obstacles from the permitting process. The result has been greater efficiency and success in managing wetlands. (See also W88-04934) (Lantz-PTT)
W88-04977

FEDERAL, STATE AND LOCAL COOPERATION IN WETLANDS PRESERVATION,
Baltimore County Office of Planning, Towson, MD.
R. W. Marriott.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 363-366.

Descriptors: *Wetlands, *Environmental protection, *Interagency cooperation, Federal jurisdiction, State jurisdiction, Local government, Chesapeake Bay, Case studies, Conservation, Management planning.

To regulate the development of wetlands effectively, local governments need the following: a team of experts available to be called on for scientific assistance; a technical, scientific and legal information clearinghouse; and, translation of scientific analysis for application to site specific problems. These needs are immediate and must be handled in conjunction with ongoing research. The Dundee-Saltpeter Creek Environmental Area (an area of 3,248 acres about 12 miles from downtown Baltimore represents one of the few large undisturbed shoreline estuarine sub-areas on the western shore of the Chesapeake Bay). Its protection is described as an example of a federal, state and local coincidence of interest in wetlands preservation. (See also W88-04934) (Lantz-PTT)
W88-04978

WETLANDS PROTECTION IN CHESAPEAKE BAY REGION - WHERE WE GO FROM HERE,
Chesapeake Bay Foundation, Inc., Annapolis, MD.
W. C. Baker.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 367-369.

Descriptors: *Wetlands, *Chesapeake Bay, *Chesapeake Bay Foundation, *Regulations, Institutions, Environmental protection, Education, Economic aspects, Enforcement, Legal aspects.

Wetlands are directly responsible for the vitality and productivity of the Chesapeake Bay. Wetlands not only provide habitat and ensure aquatic productivity, but they are also natural barriers to pollution. The three key issues addressed by the Chesapeake Bay Foundation (CBF) to make wetlands protection more effective are: (1) Education. CBF has, since the 1960's, operated a field program in estuarine education. Students from throughout the Bay region - over 22,000 annually - are provided with direct exposure to the Bay system at a number of different environmental education facilities. At each facility, students learn about the value of wetlands to the entire Bay system. Through direct testing and observation they learn about degraded water quality and about how emergent and submerged vegetation can help; (2) Incentives. CBF is able to offer incentives to private land owners to protect wetlands. Through a land conservation program, CBF is able to receive gifts in fee of land for which the donor is allowed to claim a charitable deduction; and (3) Enforcement. Enforcement of existing environmental laws has been one of this organization's highest priorities. CBF has steadfastly supported government efforts, at all levels, to enforce wetlands laws vigorously, and has the capability to bring legal action when it is felt that such laws are not being adequately enforced. Finally, the Chesapeake Bay Foundation will encourage the passage of additional legislation to more fully protect Bay area wetlands. In the future, more emphasis will be placed on the matter of more adequate protection for non-tidal wetlands. (See also W88-04934) (Lantz-PTT)
W88-04979

6F. Nonstructural Alternatives

DEPLETING THE OGALLALA: HIGH PLAINS GROUND WATER MANAGEMENT POLICIES,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4B.
W88-04924

6G. Ecologic Impact Of Water Development

ENVIRONMENTAL IMPACT OF THE SANMEN GORGE PROJECT,
Ministry of Water Resources and Electric Power, Beijing (China).
W. Xiutao.
Water Resources Journal, No. 153, p 66-68, June 1987. 5 fig, 2 ref.

Descriptors: *Environmental effects, *Dam construction, *Sanmen Gorge Project, *China, *Yellow River, Dams, Reservoirs, Sluices, River flow.

In China there are more than 130 large- and medium-sized hydropower stations with an installed capacity greater than 12 megawatt (MW), and more than 70,000 small-sized ones have been built. The reservoirs have a water surface area of some 20 x 10 to the 3rd sq km in total. Their environmental impacts are both beneficial and adverse. Through reservoir management, flood damage can be eliminated, and the downstream low water flow can be controlled. Local climate can be improved, and the reservoir's aquaculture can be increased. But there also can be adverse effects, of which some can have very serious results. For example, the problems associated with reservoir inundation and the relocation of people are sometimes difficult to deal with in China, because the country has limited farmland which has to supply a large population. Some of the rivers are heavily silt-laden, and often the reservoir sedimentation problems are very serious. The raising of the groundwater level in the area around a reservoir may cause salinization and waterlogging. The natural river flow and water quality are unavoidably changed by reservoir storage, and this will have an influence on the type and size of fish populations. In some navigable rivers, navigation is suspended during or after dam construction. In the case of the Sanmen Gorge project some of the adverse environmental impacts are worth considering for reference. However, the environmental impacts, which were not thoroughly considered in the original planning, have been the main cause of problems experienced since construction first started in 1957. At the time of its design Sanmen Gorge was the largest project to be built in China. Today, with project modifications through reconstruction and increased sluicing capacity, it is a useful example which may be used to justify a thorough environmental impact study before a future similar sized project proceeds. (Lantz-PTT)
W88-04521

DOLORES ARCHAEOLOGICAL PROGRAM: ANASAZI COMMUNITIES AT DOLORES: MIDDLE CANYON AREA,
Dolores Archaeological Program, CO.
A. E. Kane, C. K. Robinson, and D. A. Breternitz.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-202222. Price codes: A99 in paper copy, A01 in microfiche.
Book 1 of 2, September 1986. 658 p, 204 fig, 139

tab, 216 ref, 8 append. Bureau of Reclamation Contract No. 8-07-40-S0562.

Descriptors: *Dolores Archaeological Program, *Archaeology, *Anasazi, Colorado, History, Cultural resources.

This volume is a collection of published reports from the Middle Canyon area of the Dolores Project in southwestern Colorado. Included in book 1 are 2 site reports (Periman Hamlet, Rio Vista villages) produced by the Dolores Archaeological Program and an introduction to the investigations in the Middle Canyon area. (See also W88-04723) (Rochester-PTT)
W88-04722

DOLORES ARCHAEOLOGICAL PROGRAM: ANASAZI COMMUNITIES AT DOLORES: MIDDLE CANYON AREA,
Dolores Archaeological Program, CO.
A. E. Kane, C. K. Robinson, and D. A. Breternitz.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-202339. Price codes: A21 in paper copy, A01 in microfiche. Book 2 of 2, September 1986. 494 p, 131 fig, 120 tab, 236 ref, 8 append. Bureau of Reclamation Contract No. 8-07-40-S0562.

Descriptors: *Dolores Archaeological Program, *Anasazi, *Archaeology, Colorado, History, Cultural resources.

This volume is a collection of published reports from the Middle Canyon area of the Dolores Project in southwestern Colorado. Included in book 2 are 2 site reports (House Creek Village, Singing Shelter) and 3 analytical chapters coreing: (1) climate, population, and resources supply in the Middle Canyon area; (2) ceramic data and interpretations; and (3) analysis of reductive technology data. (See also W88-04722) (Rochester-PTT)
W88-04723

STATE FUNDED DAM AND RECREATION AREA TAKES CARE OF ENVIRONMENT AND HISTORY,
Kennedy/Jenks/Chilton, San Francisco, CA.
I. S. Rackley.
Public Works PUOAH, Vol. 118, No. 11, p 62-64, November 1987.

Descriptors: *Earth dams, *Outdoor recreation, *Reservoirs, Archaeology, Fisheries, Wildlife, Spillway, Saddle dam, Mitigation measures, Probable maximum flow, Nevada.

Project planning, environmental issues, mitigation measures for archeological sites, fisheries, and birds and wildlife, design challenges, and construction plans are described for the South Fork Dam and Recreation Area, Elko County, Nevada. This project, which is on the South Fork of the Humboldt River, is planned in two phases, which are scheduled for completion in 1989: (1) a rolled, earth-filled dam with a maximum height of 86 ft, a crest length of 1,800 ft, and a typical crest width of 30 ft; (2) a 40,000 ac-ft reservoir, 3.5 mi long and 1.5 mi wide; and (3) a 3,960-acre recreation area. This is the first project of its type for which Nevada state monies have been used. Preservation of numerous archeological and cultural history sites is a major environmental issue at this site. The emergency spillway system employs a saddle dam with a crest elevation 8 ft below that of the main dam and designed to deal with half the probable maximum flood for this area. (Rochester-PTT)
W88-04872

MANAGING LANDSCAPES FOR HUMANITY AND NATURE: THE ROLE OF WETLANDS IN REGIONAL NUTRIENT DYNAMICS,
Florida Univ., Gainesville. Center for Wetlands.
M. T. Brown.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 63-75, 3 fig, 1 tab, 52 ref.

Descriptors: *Wetlands, *Resources management, *Landscapes, *Environmental effects, Management planning, Environmental protection, Nutrient cycling, Water pollution control, Ecosystems, Wastewater disposal, Floods, Artificial wetlands.

Concerned primarily with the spatial manifestations of landscape processes, the new 'science of the landscape' is striving to generate theoretical principles to better understand large-scale spatial and temporal phenomena. Management strategies are beginning to reflect this new awareness of and emphasis on landscape, as evidenced by incorporation of a broader systems approach. The impact of humanity on regional nutrient budgets and cycling is widespread and pervasive. Conversion of forests and meadows to agricultural and urban uses has altered regional nutrient dynamics by changing soil chemistry and increasing soil erosion and the harvesting of forest products. In the process, by-products are released to the environment. This concentrated consumption and eventual release of by-products has influenced the chemical character of the larger environment. The relatively recent rise of human influence in the landscape has not changed the basic processes, only the speed at which they occur. While some new and unfamiliar chemical species have been released to the environment, the major influence is the spatial concentration of chemicals. Effective management of the entire landscape can be facilitated by utilizing a wide range of new 'values' possessed by wetlands, including processing wastewater and attenuating floods. 'Artificial' wetlands can be used to reverse trends in wetland loss and add new values to the landscape mosaic. (See also W88-04934) (Lantz-PTT)
W88-04940

IMPACT OF AGRICULTURAL DRAINAGE ACTIVITIES IN THE COASTAL FLATS REGION OF THE CHESAPEAKE BAY,
Fish and Wildlife Service, Annapolis, MD.
T. N. Hall.
IN: Wetlands of the Chesapeake. Proceedings of the Conference Held April 9-11, 1985, Easton, Maryland. 1985. p 199-207, 2 tab, 10 ref.

Descriptors: *Agricultural hydrology, *Environmental effects, *Chesapeake Bay, *Coastal flats, *Drainage effects, Drainage, Wetlands, Regulations, Drainage programs, Riparian wetlands, Impaired water quality.

The Watershed Protection and Flood Prevention Act and other state and local programs in Maryland and Delaware have supported extensive agricultural drainage designed to improve crop yields. Many of the areas drained, or affected by drainage, are wetlands (especially wooded wetlands). Although recent improvements have been made in both federal and state drainage regulations, these regulations are not working to alleviate the major problems of continuing wetland losses and nutrient inputs. A comprehensive program to preserve and restore wetlands and control nutrients in runoff needs to be developed. Wetlands should be protected from activities which reduce or eliminate their capacity to assimilate and recycle nutrients. Much channelized farmland, if left undisturbed, would revert to wetlands. The cumulative result of agricultural drainage has been significant loss of riparian wetland and a resultant negative impact on the water quality of the Bay, because the lost and degraded wetlands had helped trap nutrient inputs from agricultural activities released into the Chesapeake Bay. (See also W88-04934) (Lantz-PTT)
W88-04952

PENNSYLVANIA'S WETLANDS: URBANIZATION AND WATERCOURSE MODIFICATION,
Corps of Engineers, Beach Creek, PA. Foster Joseph Sayers Dam.
For primary bibliographic entry see Field 6E.
W88-04957

7. RESOURCES DATA

7A. Network Design

IMPROVED BOREHOLE SITING SUCCESS USING INTEGRATED GEOPHYSICAL TECHNIQUES,
Hydrotechnica, Shrewsbury (England).
C. C. White.
Water Resources Journal, No. 152, p 49-52, March 1987. 4 fig, 2 tab, 4 ref.

Descriptors: *Boreholes, *Groundwater resources, *Site selection, *Borehole geophysics, Resistivity, Electromagnetics, Costs, Aquifers, Groundwater supply, Transmissivity, Permeability coefficient, Zimbabwe.

An accelerated drought relief program for Victoria Province, Zimbabwe was carried out during 1983 to 1984 to help alleviate the suffering caused by drought, then coming up to its third successive year. A total of 331 sites were surveyed and pegged for either a borehole or hand dug well source over an eight month period by a siting team comprising one geophysicist/hydrogeologist and two locally hired laborers. By the end of the project 282 successful boreholes had been completed with an overall success rate of 76%. The boreholes were primarily located at sites with the greatest chances of obtaining water. This may appear obvious but other aspects of borehole location such as distance from the community, ease of access, flood and pollution risk were also very important considerations. The rationale used in siting the boreholes was to try to locate areas where the regolith was deepest so that: (1) The maximum saturated thickness and therefore storage would be available; (2) The highest transmissivity would be obtained. Previous research suggested that the frequency of fissures in the bedrock would also be greatest in these locations thereby providing the maximum possible permeability; and (3) The greater saturated thickness will maintain a borehole yield for a longer period during any drought. Two geophysical techniques were used throughout the project, the electromagnetic and resistivity methods. Electromagnetic profiling was used as a general reconnaissance tool as well as a valuable technique to locate fault zones and dyke contact zones. Resistivity surveys were carried out using an ABEM SAS300 terrameter and a BGS256 multicore cable. Depth soundings were conducted using the Offset Wenner technique which produces very high quality data by reducing the effect of subsurface lateral variations and also allows important field checks to be carried out to assess the validity of the data itself. In total 88 km of EM profiling and 257 resistivity depth sounding were conducted. The cost savings that were achieved by improved success rates when using such techniques more than compensated for the cost of siting the boreholes. Borehole siting amounted to approximately 10% ($Z960) of the total borehole cost ($Z9600). (Lantz-PTT)
W88-04515

DESIGN OF RAINFALL NETWORKS USING ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and P. F. Krstanovic.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87-234936/AS. Price codes: A04 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Completion Report, October 1986. 56 p, 15 fig, 7 tab, 29 ref, 4 append. Contract No. 14-08-0001-G1020. Project No. USGS G1020-06(5).

Descriptors: *Network design, *Model studies, *Entropy, *Rainfall data, Rainfall networks, Space-time variance, Spatial reduction, Rainfall records, Variance reduction, Space-time design, Louisiana.

Treating rainfall as a random field, models are derived using entropy for design of rainfall net-

works in space and time separately and jointly. The model for design in space offers an alternative to the model of Rodriguez-Iturve and Mejia (1974). The model for design in time is extended using entropy spectrum for reconstruction of historical rainfall data. Long-term annual rainfall data for existing networks in Louisiana are used to verify the models. The efficiency of rainfall networks is evaluated using reduction of variance of mean of a real rainfall. A comparison with some of the existing models shows that the proposed models are suitable, especially for data-scarce regions. (Singh-LA, WRRI)
W88-04762

SITE LOCATION AND INSTRUMENTATION ASPECTS OF A STUDY OF SEDIMENTATION PROCESSES IN A PROGLACIAL LAKE IN SOUTHEASTERN BRITISH COLUMBIA, CANADA,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W88-05024

WATER SUPPLY, SANITATION AND HEALTH EDUCATION PROGRAMMES IN DEVELOPING COUNTRIES: PROBLEMS OF EVALUATION,
Linkoeping Univ. (Sweden). Dept. of Pediatrics.
For primary bibliographic entry see Field 6B.
W88-05072

7B. Data Acquisition

MONITORING MOISTURE MIGRATION IN THE VADOSE ZONE WITH RESISTIVITY,
Wisconsin Univ.-Milwaukee. Dept. of Geological/Geophysical Sciences.
For primary bibliographic entry see Field 2F.
W88-04490

REPRESENTATIVE SAMPLING OF GROUND WATER FROM SHORT-SCREENED BOREHOLES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
C. Barber, and G. B. Davis.
Ground Water GRWAAR, Vol. 25, No. 5, p 581-587, September-October 1987. 5 fig, 2 tab, 10 ref.

Descriptors: *Sampling, *Groundwater quality, *Groundwater quality, *Boreholes, *Monitoring, Pumping tests, Well water, Groundwater storage.

Boreholes terminated with a short (1-3 m) length of screen are often used in groundwater quality monitoring, although to obtain representative samples, pumping is often required to overcome the effects of stagnant casing storage. Methods for estimating pumping time prior to sampling from a pumped discharge, presented graphically and in summary equations, show that for most requirements, pumping time (t sub a) to purge well storage (where mixing of casing storage and groundwater takes place within the casing) or to overcome casing storage effects (where little mixing occurs within the casing) is given by t sub a = - ln(m)(V/Q). Here V is the volume of well storage, Q is the average pumping rate, and m is given by: m = (C sub t - C sub g)/(C sub c - C sub g), where C sub t, C sub g, and C sub c are concentrations of some substance in pumpage, and groundwater, and the initial concentration in casing storage, respectively. In boreholes which have been developed and which are regularly pumped and where a relative sampling error of 2.5% is considered to be acceptable, then m has a value of 0.1. Pumping time then equates to the time necessary to pump 2.3 volumes of well storage from the borehole. Laboratory and field evaluations using boreholes in transmissive and low permeability formations generally validate the theoretical approach. The theory can be used as a basis for estimating and optimizing pumping times for monitoring programs where groundwater samples are recovered from short-screened boreholes. Additionally, the theory allows the determination of an optimum pumping rate. (Author's abstract)
W88-04492

COMPUTED TOMOGRAPHIC ANALYSES OF WATER DISTRIBUTION IN THREE POROUS FOAM MEDIA,
North Carolina State Univ., Raleigh. Dept. of Horticultural Science.
For primary bibliographic entry see Field 2G.
W88-04497

IMPROVED BOREHOLE SITING SUCCESS USING INTEGRATED GEOPHYSICAL TECHNIQUES,
Hydrotechnica, Shrewsbury (England).
For primary bibliographic entry see Field 7A.
W88-04515

VOLATILIZATION LOSSES OF ORGANICS DURING GROUND WATER SAMPLING FROM LOW PERMEABILITY MATERIALS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5A.
W88-04547

IN SITU MULTILEVEL SAMPLER FOR PREVENTIVE MONITORING AND STUDY OF HYDROCHEMICAL PROFILES IN AQUIFERS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 5A.
W88-04548

FIELD EVALUATION OF WELL PURGING PROCEDURES,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5A.
W88-04550

MINIMIZING INTERPRETATION AMBIGUITIES THROUGH JOINT INVERSION OF SURFACE ELECTRICAL DATA,
Geophysics Group, San Diego, CA.
E. P. Gustafson, and R. B. McEuen.
Groundwater Monitoring Review GWMRDU, Vol. 7, No. 4, p 101-113, Fall 1987. 17 fig, 16 ref.

Descriptors: *Geohydrology, *Joint inversion, *Data interpretation, *Electrical properties, *Geophysics, *Mathematical models, *Groundwater, *Electrical studies, Soil water, Model studies, Statistical models.

Joint inversion is an extension of standard least-squares inversion techniques. With this approach, it is possible to construct a model that is simultaneously consistent with surface observations made using more than one geophysical method. Discussion focuses on applications to the Schlumberger and audiomagnetotelluric sounding methods, although the technique is not limited to these. The authors found that the non-uniqueness problems that often plague the interpretation of electrical sounding data can be substantially reduced if the model is required to be consistent with more than one set of surface measurements. If geological ground truth is available to further constrain the model, the chances of arriving at the true physical property distribution of the subsurface are far better than if a single data set is interpreted. To demonstrate the power of joint inversion, a study is presented using synthetic data obtained from a three-layer resistivity model. Two case histories are presented to demonstrate that a much better representation of the true earth can be obtained with joint inversion than with standard interpretation methods. (Author's abstract)
W88-04552

FLOW-INJECTION ANALYSIS OF SUBSTANCES IN WATER. PART I. ANIONS. A CRITICAL REVIEW,
Pretoria Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-04563

USE OF EVAPORIMETERS FOR ESTIMATING MAXIMUM TOTAL EVAPORATION,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Agrometeorology.
W. H. Van Zyl, and J. M. De Jager.
Water SA, Vol. 13, No. 4, p 235-240, August 1986. 35 ref.

Descriptors: *Evaporimeters, *Evaporation, *Measuring instruments, Mathematical models, Evaporation gages, Irrigation requirements, Evapotranspiration.

The theory of evaporation from evaporimeters and its relationship to maximum total evaporation (Em) is reviewed. A Penman type mathematical model comprising both an energy and an aerodynamic component is proposed to explain the mechanism of evaporation from the A-pan and evaporation from a reference crop (Er). The use of a Piche evaporimeter or an evaporating carborundum surface to simulate the aerodynamic component in the Penman-Monteith equation seems a most promising alternative. This together with the evaluation of the energy term, using sunshine duration and air temperature data could result in the reliable estimation of Em. Favorable comparison between one or both of these techniques with Em should inevitably lead to better planning and management for irrigation scheduling. (Author's abstract)
W88-04568

EXAMINATION OF THE EFFICIENCY OF A SIMPLE RUNOFF PLOT SAMPLE SPLITTER,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
M. L. Bode, and A. B. Weaver.
Water SA, Vol. 13, No. 4, p 241-244, August 1986. 3 fig, 5 tab, 13 ref.

Descriptors: *Runoff, *Sampling, *Sample splitter, *Flow rate, Sediment concentration, Particle size, Surface tension, Physical properties.

The effect of flow rate, sediment concentration and sediment grain size on the efficiency of a simple runoff plot sample splitter is investigated. The major factor influencing the sampling efficiency of the splitter was flow velocity. The design sample split is only attained after a critical flow rate was exceeded. This is ascribed to surface tension at the splitter/water interface. Surface tension causes a backing up of water behind the weir at low flow rates due to differences in forces of attraction exerted between water and metal molecules adjacent to the splitter weir. The resultant backing up effect causes uneven flow across the weir crest. These forces are overcome only after a critical flow rate (0.15 l/sec) is exceeded. The performance of the splitter improves after this critical flow rate has been reached. (Lantz-PTT)
W88-04569

BROMIDE AS A CONSERVATIVE TRACER FOR SOIL-WATER STUDIES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2G.
W88-04575

TIPPING BUCKET FLOWMETER FOR ROADSIDE GULLY RUNOFF,
University Coll., London (England). Dept. of Geography.
G. E. Hollis, and J. C. Ovenden.
Hydrological Processes HYPRE3, Vol. 1, No. 4, p 391-396, November 1987. 3 fig, 2 tab, 14 ref. Natural Environment Research Council Grant No. GRS/4442.

Descriptors: *Tipping bucket flowmeters, *Roads, *Runoff rates, Flowmeters, Measuring instruments, Gullies, Flow rates, Urban hydrology, United Kingdom.

A tipping bucket flowmeter designed for the measurement of inflows to roadside gully pots is described. It is braced within the pot above the liquor and the runoff is fed to it via a glass fiber funnel

and a hose. While it can be calibrated to only 0.71/sec, it is very effective at low flows and has a number of advantages over the well known Institute of Hydrology Gully Meter. Its use at Redbourn, Hertfordshire (United Kingdom) for roads on highly permeable soils shows that, for both rainfall and artificial irrigation, the 'losses' are very large and highly variable even within a single housing estate road. (Author's abstract)
W88-04576

APPLICABILITY OF THE WASTEWATER TREATMENT PLANT IN OTHFRESEN AS SCIENTIFIC DOCUMENTATION OF THE ROOT-ZONE METHOD,
Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 5D.
W88-04615

RELATIONSHIP BETWEEN THEORY AND PRACTICE OF REAL-TIME RIVER FLOW FORECASTING,
Ruhr Univ., Bochum (Germany, F.R.).
For primary bibliographic entry see Field 2A.
W88-04692

CASE STUDIES IN REAL-TIME HYDROLOGICAL FORECASTING FROM THE UK,
Institute of Hydrology, Wallingford (England).
P. E. O'Connell, G. P. Brunsdon, D. W. Reed, and P. G. Whitehead.
IN: River Flow Modelling and Forecasting. D. Reidel Publishing Co., Dordrecht, Holland, 1986. p 195-240, 19 fig, 6 tab, 29 ref.

Descriptors: *Flow forecasting, *River forecasting, *Remote sensing, *Flood forecasting, *Paraguay, Catchment, Modelling, Flood routing, Hydrological studies, Hydrologic data, Regulated flow, Radar, Rainfall rate.

The developments which have taken place in the fields of electronic engineering and hydrological modelling over the past decade are now generating considerable operational benefits in the areas of flood warning, reservoir management and pollution control. On-line monitoring of rainfall, flow and water quality variables can be achieved with reliable instrumentation and telemetry. As more operational experience with new technology is acquired, the examination of case studies is important in selection of appropriate instrumentation, telemetry and modelling. Three case studies are given: the operation of the real-time flow forecasting system for the river Dee (North Wales) - a project aimed at developing the potential of radar for a quantitative measurement of rainfall; the real-time flood warning scheme installed in a small catchment area east of Edinburgh (Scotland); and the scheme to help protect water supply abstraction intakes from accidental pollution along the Bedford Ouse river (East Anglia). Full discussion is given of background, theoretical development, catchment and instrumentation, with an evaluation of the performance in operation and subsequent refinements. Comparison of the three schemes is made, with the conclusion that where simple models can satisfy the requirements of the scheme, their replacement by complex models should only be considered in terms of additional benefits. (See also W88-04686) (Bicht-PTT)
W88-04693

DESIGN AND OPERATION OF FORECASTING OPERATIONAL REAL-TIME HYDROLOGICAL SYSTEMS (FORTH),
World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 2A.
W88-04697

MEASUREMENT OF TRACE CONCENTRATIONS OF HYDROGEN IN BIOGAS FROM ANAEROBIC DIGESTERS USING AN EXHALED HYDROGEN MONITOR,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5D.
W88-04859

HIGH PLAINS REGIONAL AQUIFER -- MAPPING IRRIGATED AGRICULTURE USING LANDSAT DATA,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
G. Thelin.
IN: Proceedings of the Ogallala Aquifer Symposium II, Lubbock, Texas, June 1984. 1984. p 40-47, 4 ref.

Descriptors: *Remote sensing, *Water use, *Groundwater irrigation, *High Plains Regional aquifer, *Groundwater management, *Satellite technology, *Mapping, *Mathematical models, Groundwater movement, Irrigation efficiency, Hydrologic data collections, Hydrologic maps, Hydrologic models, Cluster analysis.

Data from 94 Landsat scenes were used to map irrigated agriculture above the High Plains aquifer. Irrigated acreage estimates are one critical element in a groundwater flow model being used by the U.S. Geological Survey to determine the current trends in the amount and distribution of irrigation water. Several methods for determining irrigated acreage were evaluated. Digital analysis of Landsat data proved to be the most suitable approach and was used in a two-phase mapping effort using Landsat digital data from both the 1978 and 1980 growing seasons. The first phase, a test of analytical procedures, used 1978 Landsat data to map the majority of the High Plains. The test employed a cluster analysis technique to derive acreage estimates of irrigated agriculture, dryland agriculture, and rangeland using 35 summer Landsat scenes. Based on the first-phase test results, several modifications were made to improve analytical techniques for the second-phase operational mapping using 1980 Landsat data. The analysis of 1980 data used a ratio technique to analyze 59 spring and summer Landsat scenes. Acreage estimates of irrigated agriculture, dryland agriculture, and rangeland were aggregated to form a data base containing approximately 20,000 grid cells measuring 1-minute of latitude by 1-minute of longitude. Percentages for each cover type were calculated and then combined with sampled irrigation application rates for use in the groundwater flow model to compute estimates of irrigation water use. (See also W88-04894) (Author's abstract)
W88-04897

PRELIMINARY ESTIMATES OF OGALLALA-AQUIFER RECHARGE USING CHLORINE IN THE UNSATURATED ZONE, CURRY COUNTY, NEW MEXICO,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
For primary bibliographic entry see Field 2F.
W88-04918

BED FORM DIAGRAMS AND THE INTERPRETATION OF ESKERS,
Wilfrid Laurier Univ., Waterloo (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W88-05020

SITE LOCATION AND INSTRUMENTATION ASPECTS OF A STUDY OF SEDIMENTATION PROCESSES IN A PROGLACIAL LAKE IN SOUTHEASTERN BRITISH COLUMBIA, CANADA,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W88-05024

CONE PENETRATION TESTING IN SNOW,
For primary bibliographic entry see Field 2C.
W88-05053

UNDRAINED SHEAR STRENGTH FROM PIEZOCONE TESTS,
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
For primary bibliographic entry see Field 8D.
W88-05055

STUDY OF THE EXTRACTION CONDITIONS OF SEDIMENTARY HUMIC ACIDS TO ESTIMATE THEIR TRUE IN SITU SULFUR CONTENT,
British Columbia Univ., Vancouver. Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W88-05106

FLUOROCHROME-STAINING TECHNIQUE FOR COUNTING BACTERIA IN SALINE, ORGANICALLY ENRICHED, ALKALINE LAKES,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W88-05107

7C. Evaluation, Processing and Publication

PUMPTEST.BAS: A PROGRAM TO CALCULATE TRANSMISSIVITY AND STORATIVITY,
Nebraska State Dept. of Environmental Control, Lincoln.
For primary bibliographic entry see Field 2F.
W88-04494

COMPARISON OF GROUND WATER MONITORING DATA FROM CERCLA AND RCRA SITES,
Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV. Environmental Chemistry Dept.
R. H. Plumb.
Groundwater Monitoring Review GWMRDU, Vol. 7, No. 4, p 94-100, Fall 1987. 3 fig, 4 tab, 13 ref. EPA Contract Nos. 68-03-3050 and 68-03-3245.

Descriptors: *Data evaluation, *Groundwater quality, *Resource Conservation and Recovery Act, *Monitoring, *Groundwater pollution *Comprehensive Emergency Response Compensation and Liability Act, Wells, Disposal sites, Path of pollutants, Organic compounds, Regulations.

Groundwater quality data generated during the investigation of 334 hazardous waste disposal sites were used to contrast the Resource Conservation and Recovery Act (RCRA) and Comprehensive Emergency Response, Compensation and Liability Act (CERCLA) monitoring programs. The minimum RCRA-required network of four wells was equaled or exceeded at 94% of the 156 RCRA sites and 70% of the 178 CERCLA sites in the data base. A sampling frequency of four events per year or more was used at 60% of the RCRA sites compared to only 24% at the CERCLA sites. CERCLA records compiled to date indicate that 480 compounds have been detected and another 220 compounds have been tentatively identified in groundwater in the vicinity of hazardous waste disposal sites. However, the composite data from 123 RCRA site monitoring programs only indicate the presence of 100 chemical substances. The most significant discrepancy in the RCRA detection monitoring program is that it only generates data on three of the 20 organic contaminants that have been most frequently detected during the CERCLA hazardous waste disposal site investigations. Modification of the current RCRA program to include routine analysis for volatile organic compounds would correct this weakness. (Author's abstract)
W88-04551

JOINT RANK TEST FOR ASSESSING MULTIVARIATE NORMALITY IN HYDROLOGIC DATA,
Northest Hydraulic Consultants, Inc., Kent, WA.
K. M. Leytham.
Water Resources Research WRERAO, Vol. 23, No. 12, p 2311-2317, December 1987. 11 fig, 3 tab, 9 ref. EPRI Project No. RP 2194-1.

Descriptors: *Data interpretation, *Forecasting, *Multivariate analysis, *Drought, *Hydrologic

data, Statistical analysis, Historic data, Hydrologic models, Mathematical analysis.

Application of stochastic hydrology to the synthesis of multisite data have commonly assumed that the historic data, or some suitable transform, may be treated as a sample from a multivariate normal distribution. This assumption, generally made for mathematical tractability, is rarely subject to verification. A new test for multivariate normality, based on the properties of joint ranks, is presented, and is of particular value in the synthesis of drought at multiple sites. Two examples are presented wherein the assumption of joint normality appears to be questionable in that the synthetic records contain fewer occurrences of joint flow events than might be expected from examination of the historic record. (Lantz-PTT)
W88-04612

DEVELOPMENT OF A COMPUTERIZED WATER BALANCE PROGRAM FOR THE EASTERN ARKANSAS REGION COMPREHENSIVE WATER SUPPLY STUDY,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 6D.
W88-04668

QUANTIFYING SURFACE WATER SUPPLIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
S. K. Martin.
IN: Proceedings of the Seventeenth Mississippi Resources Conference, March 25-27, 1987, Mississippi. 1987. p 13-17, 4 fig, 1 tab, 3 ref.

Descriptors: *Surface water, *Water supply, *Quantitative analysis, *Irrigation, *Water management, *Arkansas, *Hydrologic budget, Water demand, Water use, Competing use, Costs, Reservoirs.

In the Eastern Arkansas Region Comprehensive Study conducted by the US Army Corps of Engineers, Memphis District, all water resources were identified and quantified for a water balance analysis. The study was undertaken to identify areas in which deficit water supplies occurred or were projected to occur, and to propose alternatives for alleviating the problems. The results provided the location of cells where projected demands exceeded the present allocation of subsurface supplies. Alternatives were evaluated in which unmet demands were satisfied by using surface supplies that were available within the cell first, then by feasible supplies in adjacent basins. Since these unmet demands were for irrigation, a distribution system was designed using pumps, control structures, new reservoirs, and distribution canals to convey the surface supplies to the areas in need. The project was deemed to be cost effective and is currently in a feasibility phase of study. (See also W88-04665) (Lantz-PTT)
W88-04669

RIVER FLOW MODELLING AND FORECASTING.
For primary bibliographic entry see Field 2E.
W88-04686

THEORY OF FLOOD ROUTING,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04688

FORECASTING MELTWATER RUNOFF FROM SNOW-COVERED AREAS AND FROM GLACIER BASINS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Physics.
For primary bibliographic entry see Field 2C.
W88-04690

TIME-SERIES METHODS AND RECURSIVE ESTIMATION IN HYDROLOGICAL SYSTEMS ANALYSIS,
Lancaster Univ. (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 6A.
W88-04691

RIVER FLOW SIMULATION,
Waterloopkundig Lab. te Delft, Emmeloord (Netherlands). De Voorst Lab.
For primary bibliographic entry see Field 2E.
W88-04694

FORECASTING AND WARNING SYSTEM OF THE 'RIJKSWATERSTAAT' FOR THE RIVER RHINE,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 2E.
W88-04695

SHORT RANGE FLOOD FORECASTING ON THE RIVER RHINE,
Waterloopkundig Lab. te Delft, Emmeloord (Netherlands). De Voorst Lab.
For primary bibliographic entry see Field 2E.
W88-04696

CASE STUDIES ON REAL-TIME RIVER FLOW FORECASTING,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-04698

PMF (PROBABLE MAXIMUM FLOOD) STUDY FOR NEVADA NUCLEAR WASTE STORAGE INVESTIGATION PROJECT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2E.
W88-04725

NHIMS, NORTHWEST HYDROLOGIC INFORMATION MANAGEMENT SYSTEM, USER'S MANUAL,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. J. Bluske, M. Mulnau, and K. Craine.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128129/AS. Price codes: A06 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, August, 1987. 109 p, 31 fig. Contract No. 14-08-0001-G1222. Project No. USGS G1222-32.

Descriptors: *Hydrologic data, *Information retrieval, *Climatic data, *Data collection, Computer programs.

Between 1975 and 1987, a data management system called HISARS (Hydrologic Information Storage and Retrieval System) was used at the University of Idaho to store and retrieve climatic and hydrologic information. HISARS was originally developed at North Carolina State University by E.H. Wiser. However, due to its age and original design, the maintenance of the HISARS system became difficult, and it was decided to replace it with a new, SAS BASED SYSTEM. The objective of the NHIMS system is to provide users with the same easy access to information as found in HISARS, but with a system that is easier to maintain and modify. (Bluske-IWRRI)
W88-04745

PROCEEDINGS, SEVENTEENTH MISSISSIPPI WATER RESOURCES CONFERENCE, 25-26 MARCH 1987, JACKSON, MISSISSIPPI.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 6B.
W88-04749

ASSESSMENT OF THE GROUND-WATER RESOURCES OF THE TEXAS HIGH PLAINS,
Texas Dept. of Water Resources, Austin. Data and Engineering Services Div.
For primary bibliographic entry see Field 2F.
W88-04907

ESTIMATION OF SPECIFIC YIELD USING DRILLERS' LITHOLOGIC DESCRIPTIONS,
Texas Dept. of Water Resources, Austin. Data Collection and Evaluation Section.
For primary bibliographic entry see Field 2F.
W88-04909

USE OF COMPUTER SOFTWARE TO IMPROVE THE ENERGY EFFICIENCY IN DEEP WELL WATER PUMPING,
Amarillo City Water Superintendent, TX.
For primary bibliographic entry see Field 4B.
W88-04911

NATIONWIDE DISTRIBUTION OF RA-228, RA-226, RN-222, AND U IN GROUNDWATER,
RPA International, Inc., Columbia, SC.
For primary bibliographic entry see Field 5B.
W88-04995

HYDROGEOLOGIC CONTROLS ON THE OCCURRENCE OF RADIONUCLIDES IN GROUNDWATER OF SOUTHERN ONTARIO,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W88-05007

LARGE LAKE MODELS - USES, ABUSES, AND FUTURE,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
For primary bibliographic entry see Field 2H.
W88-05038

EVALUATION OF THE IMPORTANCE OF TRANSMISSIVITY, HEAD AND CONCENTRATION DATA FOR CONTAMINANT TRANSPORT MODELLING,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 5B.
W88-05044

8. ENGINEERING WORKS

8A. Structures

TRENCHLESS SEWER-LAYING: MOLES AND PLASTIC SAVE TIME AND TROUBLE,
For primary bibliographic entry see Field 8C.
W88-04514

SPILLWAY REPAIRS AT BHAKRA DAM,
Bhakra Managment Board, Nagul (India).
R. K. Malholtra, M. L. Agarwal, and A. P. Bhat.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 10, p 16-21, October 1987. 7 fig, 3 tab.

Descriptors: *Spillways, *Bhakra Dam, *Construction methods, *Maintenance, Pneumatic techniques, Concrete Construction.

The 225.5 m-high Bhakra concrete dam suffered considerable damage to its spillway stilling basin as a result of years of abrasion from gravel and boulders passing through the structure during flood discharge. Various methods of concrete repair were investigated, the main restriction being the necessity of allowing the two powerplants (which lie either side of the spillway) to remain operational while the repair work was being carried out. The method of repair which was adopted was the pneumatic caisson technique, wherein air pressure was applied to the caisson to avoid the excessive removal of ballast and to allow the caisson to float. An air pressure of about 1.25 kg/sq cm was sufficient to float the caisson. Before the caisson was

suspended, the tailwater level was fixed, to protect the equipment against a sudden change in the level. Grounding of the caisson was performed by releasing the air pressure from inside the caisson and simultaneously lowering the unit with chain pulley blocks. Water was subsequently pumped into the wall cavity together with the required ballast to ensure a net minimum downward load of 40 to 50 to. When the water had been depressed to its lowest level, the concrete was washed by an air/water jet to remove all debris including silt and sand. All loose, damaged and deteriorated concrete was either chipped off manually or with pneumatic tools. The removal of unsound, damaged or deteriorated concrete was very important for the success of the repair and, therefore, a thorough inspection of the bed was conducted prior to each repair process. The concrete was repaired with the use of narrow forms of a suitable width taking into account the rate of concrete delivery from outside the caisson and also the pot life of the new concrete. A coating of pre-mixed epoxy concrete bonding (with a strength of 27.5 N/sq mm) was applied to the bed and sides of the construction joints. The new concrete was prepared in a diesel-driven mixer installed on the pontoon, and was carried in buckets through the air lock. (Lantz-PTT)
W88-04531

REBUILDING THE HOLLOW-JET OUTLET VALVES AT MONTICELLO DAM,
Bureau of Reclamation, Sacramento, CA.
R. Fairall, C. Quinton, R. L. Wood, and T. Simms.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 10, p 22-26, October 1987. 2 fig.

Descriptors: *Outlets, *Valves, *Monticello Dam, *California, *Maintenance, Construction methods, Hydraulic structures.

Extensive cavitation damage to the two hollow-jet valves at Monticello dam, part of the Solano project, California, was noted when the valves were examined in June 1980. The valves were installed during construction of the dam, which took place in 1954. Because of the deteriorated condition of the valves and the probable losses resulting from a failure, the decision was made to repair both valves to their original, or a better than original, condition. A description of the known and probable condition of the valves was included, together with a statement of the repair to be performed, in a tender. the lowest qualified bidder was selected and the two hollow-jet valves, together with the auxiliary pivot valves, were repaired and are now operating satisfactorily. The condition of the two hollow-jet valves; the operation and maintenance problems which dictated the repair sequence and schedule; the welding, fabrication, and testing problems and solutions; and, a summary of the lessons learned from the experience which could be applicable to future repairs of similar valves are described. (Author's abstract)
W88-04532

OPTIONS FOR REFURBISHMENT: THREE CASE STUDIES IN ITALY,
For primary bibliographic entry see Field 8C.
W88-04536

OVERVIEW OF SMALL HYDRO DEVELOPMENT IN CANADA,
For primary bibliographic entry see Field 8C.
W88-04537

REPAIR OF NEW EXCHEQUER DAM,
Tudor Engineering Co., San Francisco, CA.
H. M. Brown, and P. R. Kneitz.
International Water Power and Dam Construction, Vol. 39, No. 9, p 25-29, September 1987. 6 fig, 5 ref.

Descriptors: *New Exchequer Dam, *Hydraulic structures, *Maintenance, Concrete, Dams, Construction joints, Infilling.

Recent modifications to the face slab and joints of the New Exchequer Dam, California, a concrete-faced rockfill dam, which included joint infilling and installation of watertight joint covers, have significantly reduced the leakage flows, which had occurred since initial operation of the dam, to 3.7 cu ft/sec. Subsequent performance suggests this type of repair is particularly effective in controlling face slab leakage on dams of this type. (Author's abstract)
W88-04538

TURNKEY APPROACH AT CALAVERAS SAVES TIME AND MONEY,
Atkinson (Gay F.) Construction Co., South San Francisco, CA.
P. Bossert.
International Water Power and Dam Construction, Vol. 39, No. 9, p 30-32, September 1987. 5 fig.

Descriptors: *Calaveras project, *North Fork Stanislaus River, *Management planning, *Hydraulic structures, *Construction costs, Financing, Water resources development.

General aspects of the North Fork Stanislaus river hydroelectric development project, known as the Calaveras project, are described. Project financing and development, and construction progress are discussed. Calaveras County Water District (CCWD), the owner and licensee, with the support of the Northern California Power Authority (NCPA) as a power developer and power purchaser, invited leading contractors to form turnkey teams including consulting engineers to be prequalified. The three short-listed teams were invited to submit fixed lump sum price proposals for the turnkey design, construction and quality control of the project. By requiring the successful contractor to take virtually all of the construction and design risk, and also requiring the provision of contract security and acceptance of severe penalties for late completion by the contractor, an underlying guarantee for complete project cost was readily obtainable. With the turnkey design and construction under the direction of one leader, the project schedule is planned to allow for work to proceed in a coordinated and simultaneous manner, allowing the plant to produce revenue at an earlier date than would otherwise have been possible, and to reduce financial costs significantly. This is accomplished by setting a common goal for all parties, improving the exchange of information, adding flexibility to the project and accelerating the approval process. The owner benefits with considerable savings in time and money when a single contractor maintains full responsibility and provides performance guarantees throughout the project. (Lantz-PTT)
W88-04539

POWERHOUSE RESTORATION USING F.E.M. MODELLING,
Beck (R.W.) and Associates, Seattle, WA.
M. J. Carney, A. X. Sison, and R. A. Hokenson.
International Water Power and Dam Construction, Vol. 39, No. 9, p 36-40, September 1987. 6 fig.

Descriptors: *Hydroelectric plants, *Restoration, *Finite element models, Model studies, Hydraulic engineering, Hydraulic structures.

A lightning storm caused severe damage to the Upriver dam hydroelectric project, City of Spokane, Washington, in the early morning hours of 20 May 1986. An appraisal of the damage to No. 1 powerhouse concluded that: the tile in the powerhouse precluded operating the units out-of-plumb; and the cost of restoring the powerhouse would be less than the cost of building a new one. The preliminary design for restoring the powerhouse included jacks supported on concrete piles at both ends of the powerhouse. Finite element models offered the potential for design improvements. At the end of every analysis, the results are compared with a reference criterion to determine acceptability of design. Typically, codes provided safety factors which protect designers from material defects, construction errors, fatigue and crude analysis techniques. The finite element powerhouse model was constructed and analyzed relatively rapidly. Conceived as a final check just before jacking, it offered confidence in the design and insight into the behavior of the powerhouse. It suggested that finite element analyses could be accomplished within a reasonable amount of time where conventional methods were inadequate. The current available software allowed for the shaping of the powerhouse elements to accommodate irregular openings. With practice, model generation time can become acceptable even with large, complicated structures. As the cost of computing power continues to decline, and software improves, finite element analysis will be an affordable, rapid method of analysis for problems of all sizes. (Lantz-PTT)
W88-04540

DRILLING AND CONSTRUCTING MONITORING WELLS WITH HOLLOW-STEM AUGERS, PART 1: DRILLING CONSIDERATIONS,
Bennett and Williams, Inc., Columbus, OH.
G. Hackett.
Groundwater Monitoring Review GWMRDU, Vol. 7, No. 4, p 51-62, Fall 1987. 15 fig, 2 tab, 19 ref.

Descriptors: *Monitoring wells, *Augers, *Drilling, *Construction, Groundwater pollution, Construction methods, Geohydrology, Construction equipment, Heaving sands, Casings, Well construction.

Hollow-stem augers are a widely used drilling method for constructing monitoring wells in unconsolidated materials. The drilling procedures used when constructing monitoring wells with hollow-stem augers, however, are neither standardized nor thoroughly documented in the published literature. Variations in drilling procedures and techniques may occur as a result of the: (1) type of auger drill equipment and formation samplers used; (2) hydrogeologic conditions at the site, especially where heaving sands occur; and (3) known or suspected presence of contaminated zones, where there is a potential for the vertical movement of contaminants within the borehole. In a saturated zone in which heaving sands occur, changes in equipment and drilling techniques are required to provide a positive pressure head of water within the auger column. This may require the addition of clean water or other drilling fluid inside the augers. When monitoring the quality of groundwater below a known contaminated zone, hollow-stem auger drilling may not be advisable unless protective surface casing can be installed. Depending on the site hydrogeology, conventional hollow-stem auger drilling techniques alone may not be adequate for the installation of the protective surface casing. A hybrid drilling method may be needed that combines conventional hollow-stem auger drilling with a casing driving technique that advances the borehole and surface casing simultaneously. (Author's abstract)
W88-04546

NEW ZEALAND'S CLYDE POWER STATION,
Ministry of Works and Development, Wellington (New Zealand).
For primary bibliographic entry see Field 8E.
W88-04577

MICRO HYDRO SCHEMES IN PAPUA NEW GUINEA,
Edinburgh Univ. (Scotland). Dept. of Electrical Engineering.
For primary bibliographic entry see Field 8C.
W88-04578

WYANGALA HYDRO PROJECT IN AUSTRALIA,
Camp Scott Furphy Pty Ltd., Melbourne (Australia).
For primary bibliographic entry see Field 8C.
W88-04579

BURDEKIN FALLS DAM,
Queensland Water Resources Commission, Bris-

bane (Australia).
B. J. Shannon.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 12, p 35-36, 41-42. December 1987. 3 fig.

Descriptors: *Burdekin Falls dam, *Australia, *Hydraulic structures, *Burdekin River, Concrete dams, Gravity dams, Dams, Spillways, River flow, Reservoirs.

Burdekin Falls dam is the largest concrete gravity dam built in Australia in recent time. The dam, built on the Burdekin River, Queensland, contains 650,000 cu m of concrete and will impound a storage of 1,860,000 Ml. Concrete for the dam was a conventional mix with large aggregate; it incorporated fly ash. A novel feature of the construction method was the transport of the concrete from the batch plant to the forms by haul trucks. The haulage required the trucks to pass over new concrete, along the tops of the monoliths. Because of the bulk handling capacity of this method, construction proceeded rapidly, with up to 40,000 cu m being placed in a month. A spillway section, over 500 m long, will pass floods up to 64,600 cu m/sec. Monoliths for the dam are of conventional design, but no energy dissipator is provided for the spillway because of the high quality of the rock foundation and the absence of tailwater. (Lantz-PTT)
W88-04580

ANIWHENUA HYDROELECTRIC SCHEME,
Tonkin and Taylor Ltd., Auckland (New Zealand).
G. A. Pickens, B. W. Leyland, and J. N. Duder.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 12, p 42-47, December 1987. 6 fig, 2 tab, 7 ref.

Descriptors: *Hydroelectric power, *Aniwhenua reservoir, *New Zealand, Hydraulic structures, Geology, Dam construction, Concrete, Economic aspects, Costs, Dams.

The 25 MW Aniwhenua hydro scheme in the eastern Bay of Plenty, New Zealand, was commissioned in 1980 within three years of construction beginning, despite complex geology at the site. Innovative design, and rapid implementation of both design and construction enhanced the cost-effectiveness of the station. The more unusual features of the equipment and structures (seismic aspects; barrage concrete structure and mechanical items; barrage embankment dam; and, headpond dam and power intake arrangements), and how they were adapted to local conditions, are described, together with the methods used to expedite construction and minimize costs. (Lantz-PTT)
W88-04581

TEST PROGRAM IMPROVES SEWER REHABILITATION,
RJN Environmental Associates, Inc., Wheaton, IL.
For primary bibliographic entry see Field 5D.
W88-04664

MUDDY CREEK GRADE CONTROL STRUCTURES, MUDDY CREEK, MISSISSIPPI AND TENNESSEE,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 4D.
W88-04677

METHOD OF AND STRUCTURE FOR ERECTING AN ARTIFICIAL ISLAND,
Dyckerhoff und Widmann A.G., Munich (Germany, F.R.
T. Struve, and H. Neumann.
U. S. Patent No. 4,487,526; December 11, 1984, 7 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1049, No 2, p 720, December 11, 1984.

Descriptors: *Patents, *Offshore platforms, *Construction methods, *Concrete construction, Ocean bottom, Reinforced concrete, Prestressed concrete, Sealants.

An artificial island is constructed by initially partitioning a concrete support on the ocean bottom. The prestressed or reinforced concrete structure extends slightly above sea level. A work area at the top of the support structure is enclosed by a housing, which is sealed at its lower end with respect to the outer wall of the support and at its upper end relative to the platform, when it is set in position. The housing includes a cover plate which rests at its underside on lifting devices arranged at the upper end of the support structure and at its upper side mounts bearings for the support of the platform. An upwardly extending circular edge wall is provided on the upper side of the cover plate to protect the bearings. A frustoconical section at the lower end of the housing tapers inwardly toward the support. Devices may be incorporated into the housing to support it in the radial direction relative to the support structure. Inflatable sealing hoses are arranged to seal the gaps between the support and the housing or between the housing and the platform. The sealing hose for the gap between the housing and the platform is arranged on the upper end of a wall encircling the upper side of the cover plate. (Cremmins-AEPCO)
W88-04767

ARCTIC CAISSON SYSTEM,
Watt (Brian) Associates, Inc., Houston, TX.
J. N. Birdy, and D. N. Bhula.
U. S. Patent No. 4,478,537; October 23, 1984, 9 p, 9 fig, Official Gazette of the United States Patent Office, Vol 1047, No. 4, p 1612, October 23, 1984.

Descriptors: *Patents, *Offshore platforms, *Construction methods, *Ice-water interfaces, *Arctic, *Caissons, Ocean bottom, Berms, Ice pressure, Concrete construction, Concretes.

A cellular caisson unit for operations in arctic and subarctic regions includes a base slab, an outer ice resisting perimeter wall, a top slab, an ice deflector positioned above the perimeter wall, and an interior made up of honeycombed, vertical walled circular units which provide load bearing strength, and storage space for ballast and production products. The interior cellular arrangement distributes the environmental loading imposed by ice. The ice deflector prevents ice from coming aboard the main deck of the marine structure. This gravity structure resists the ice loading by virtue of its own weight and the weight of any ballast that may be introduced within it. The structure may be built in concrete, reinforced concrete, post-tensioned concrete, a combination of reinforced post-tensioned concrete, or other similar cementitious material, as is dictated by the loading requirements imposed by the environment. The structure may be towed under its own buoyancy and installed on relatively uniform sea beds by ballasting with sea water. (Cremmins-AEPCO)
W88-04768

PYRAMIDAL OFFSHORE STRUCTURE,
Conoco, Inc., Ponca City, OK.
R. L. Grimsley, and L. J. Gawel.
U. S. Patent No. 4,437,794; March 20, 1984, 12 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1040, No 3, p 1150, March 20, 1984.

Descriptors: *Patents, *Offshore platforms, *Construction methods, *Buoyancy, *Flotation, Storage, Underwater, Hydrocarbon.

A buoyant or floating pyrimidal offshore platform for operations in shallow or deep water can be modified to form a rigidly supported platform on the bed of the body of water. Structures for underwater storage of hydrocarbons produced from the platform are provided. The platform comprises a level flotation adjustable center section formed from a geometric configuration containing at least three floation adjustable members supporting at least three upper members. The members join to form an upper apex and have at least one horizontal platform supported by the upper members. Preferably the structure forms a tetrahedron, which is used in shallow waters wherein part of the structure can be supported by the bed of the body of water. For deeper water, the level flotation adjustable center section would also contain at least three lower members to form a lower apex. This apex would also describe a hexahedron. Thus a dual pyramid structure would be formed. The geometric configuration of any two adjacent upper members in the horizontal center section would be an isosceles triangle as would be the geometric configuration of any two adjacent lower members. Horizontal working platforms can be provided, normally above water level, which includes levels both above and below the upper apex. In the lower section, a rigid jack-leg can extend downward from the lower apex with a weight and depth adjustable balance moveably to it to minimize the pendulum effect of the platform. (Cremmins-AEPCO)
W88-04769

BARGE HULL FOR OFFSHORE DRILLING RIGS,
Marathon Mfg. Co., Houston, TX.
D. B. Lorenz.
U. S. Patent No. 4,455,109; June 19, 1984, 7 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1043, No 3, p 1105, June 19, 1984.

Descriptors: *Patents, *Offshore platforms, *Construction methods, *Ice-water interfaces, *Arctic, *Caissons, Ocean bottom, Berms, Ice pressure, Concrete construction, Concretes.

An improved barge hull decreases towing resistance as offshore drilling rigs are towed to drilling sites. A channel extends from the bottom of the barge hull to direct the flow of water under the hull to its back end to create hydrodynamic turbulence sufficient to disrupt the relative hydrodynamic stability of a body of water immediately behind the hull when it is being towed. (Cremmins-AEPCO)
W88-04770

MODULAR ARCTIC STRUCTURES SYSTEM,
Mobil Oil Corp., New York.
G. H. Reusswig.
U. S. Patent No. 4,486,125; December 4, 1984, 14 p, 13 fig, 4 tab. Official Gazette of the United States Patent Office, Vol 1049, No 1, p 233, December 4, 1984.

Descriptors: *Patents, *Offshore platforms, *Construction methods, *Oil fields, *Drilling equipment, Ice loads, Ice pressure, Arctic, Flotation, Exploration.

An oil or gas exploration or drilling platform derives its stability and ability to resist large horizontal shear loads from its massive gravity base, which is floated to a site and then submerged to the seabed using a ballasting method. The platform is intended for use in waters about 20 to 100 ft deep. The modular base structure is normally ballasted down into a predredged hole or cavity. The structure has high resistance to horizontal shear loads 30 feet below the mean water plane. The platform is equipped with an ice impacting structure capable of withstanding 1200 lbs/sq in pressure over a large circumferential area. The outer periphery of the platform is heated and sloped so as to convert horizontal shear loads exerted by the ice into tensile stresses that tend to fracture the ice rather than forming resistance along the compression line of the ice sheet. Thus, the lower base of the platform serves as an ice deflector, breaker, and shield. (Cremmins-AEPCO)
W88-04771

SYSTEM AND METHOD FOR POSITIONING AN OFF-SHORE PLATFORM ON A SUPPORT,
Ateliers et Chantiers de Bretagne, Nantes (France).
J. Ninet.
U. S. Patent No. 4,413,926; November 8, 1983. 6 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1036, No 2, p 546, November 8, 1983.

Descriptors: *Patents, *Offshore platforms, *Barges, *Construction methods, Bottom water, Piles, Rigid foundations.

Barge-mounted offshore platforms are positioned on support structures fixed to the sea bed, and include at least two upstanding piles having platform-receiving guides at their upper ends. The platforms include legs for fixing to corresponding ones of the piles. At least two of the legs are hollow and are provided with plungers slideably mounted for cooperating with the platform-receiving guide. Each plunger has a releasable fastening capable of holding the plunger fixed in its leg, and of releasing it suddenly on command to engage with the platform-receiving guide system. The releasable fastenings of at least two of the plungers are arranged to release simultaneously. Each releasable fastening includes at least one finger passing through the leg and through a bore in the plunger. (Cremmins-AEPCO)
W88-04772

OFFSHORE PLATFORM HAVING THREE DECKS,
Conoco, Inc., Ponca City, OK.
R. G. Goldsmith.
U. S. Patent No. 4,305,466; December 15, 1981. 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1013, No 3, p 902, December 15, 1981.

Descriptors: *Patents, *Offshore platforms, *Drilling equipment, *Oil wells, Deep wells, Subsurface water, Barriers, Ocean bottom, Oil fields.

Offshore platforms comprising three decks in the wellbay area support the drilling of wellbores to reach subterranean formations and the production of fluids from them. A lower deck provides a workspace for positioning equipment to be lowered to the ocean floor; a middle deck functions as the main production deck from which the risers from the wellbores are supported and from which production operations are conducted after completion of the wellbores; and an upper deck supports drilling, completion, and workover equipment, and acts as a protective barrier between such equipment and the second deck. (Cremmins-AEPCO)
W88-04773

JACKUP PLATFORM TRAILER,
Shell Oil Co., Houston, TX.
R. R. Ayers.
U. S. Patent No. 4,380,406; April 19, 1983. 5 p, 2 fig, 3 ref. Official Gazette of the United States Patent Office, Vol 1029, No 3, p 648, April 19, 1983.

Descriptors: *Patents, *Offshore platforms, *Flotation, *Pontoons, Underwater, Boats.

A jackup platform trailer comprising a floatable deck structure supported by submersible flotation facilitates offshore handling and transfer operations in rough weather. The deck structure is towable by a conventional vessel such as a supply boat. It is pivotable from a raised transit mode to a lowered mode from which the flotation system is fully submerged until it rests on the bottom. With the jackup trailer/work platform, workmen can do useful work on a stable, dry deck. Also, men and equipment can be easily and safely transferred from the jack-up trailer to a subsea location or upward to an offshore platform or larger floating vessel. In a transport mode, the deck structure is linked via a gooseneck arm and swivel joint to a workboat. In an operational mode, the submersible flotation system is fully submersed to support the deck structure from the ocean floor, without need for an attached workboat. (Cremmins-AEPCO)
W88-04774

MODULAR FLOATING DOCK,
D. Guibault.
U. S. Patent No. 4,604,962; August 12, 1986, 7 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1069, No 2, p 569, August 12, 1986.

Descriptors: *Patents, *Docks, *Flotation, *Locking, *Wave action, Nuts, Bolts, Screws, Cleats, Bumpers.

An interlocking bolt and nut assembly for modular floating docks is arranged so as to prevent release of the assembly by wave action. The assembly can be used to attach bumpers and cleats to the sides of the dock. It comprises eye lugs projecting from the corners of the floating units at different levels so that they may be superposed. When, for instance, four floating units are joined together, a bolt with an enlarged head and a threaded spindle is inserted from above through the superposed eye lugs and screwed into a nut underlying the lowermost lug. A nut holding anti-rotation system holds the nut in position and prevents its rotation when the bolt is screwed into the nut. The enlarged conical shape of the head comes into frictional engagement with matching frusto-conical corner surfaces of the floating units and thus positively prevents inadvertent unscrewing of the bolt. The nut holding and anti-rotation system includes a pair of upstanding parallel flanges of L-shape cross-section. The flanges protrude from one end face of the nut and slidably engage into side grooves formed at the top surface of the lowermost lug of each floating unit. (Cremmins-AEPCO)
W88-04775

BOX GIRDER AND SUSPENSION ASSEMBLY,
C. R. Rolen.
U. S. Patent No. 4,615,063; October 7, 1986, 5 p, 3 fig. Official Gazette of the United States Patent Office, Vol 1071, No 1, p 16, October 7, 1986.

Descriptors: *Patents, *Bridges, *Bridge construction, *Construction methods, *Load distribution, Suspension, Girders, Walkways.

A box girder and suspension assembly for walkways and bridges distributes the load on the girder more evenly by providing an additional area of contact between the girder and a stop member carried on the anchoring rod. The hanger or anchoring rod is provided with a sleeve that engages the stop member at one end and the upper wall of the girder at its opposite end. Thus, the load resistance provided by the suspension cable is transmitted directly to both the upper and lower walls of the girder. The stop element carried on the suspension member is sized to span the lower wall opening, and the load-distributing device carried on the suspension member is sized for passage through the lower wall opening and for engagement at opposite ends with the stop member and the upper wall of the girder. (Cremmins-AEPCO)
W88-04776

TRANSPORTABLE PONTOON,
Ministry of Defence, London (England).
J. P. Fitzgerald-Smith.
U. S. Patent No. 4,561,376; December 31, 1985, 6 p, 4 fig. Official Gazette of the United States Patent Office, Vol 1061, No 5, p 1974-1975, December 31, 1985.

Descriptors: *Patents, *Pontoons, *Bridge construction, *Bridges, *Ships, Transportation, Construction methods, Bulkheads, Plates, Hulls, Beams.

A foldable pontoon for use in bridging or ferrying can be deployed rapidly and requires minimal enclosed air space during transport. Substantially planar hull members, each having a keel edge and a parallel gunwale edge, are successively hinged in sealed relationship at alternately conjoined keel and gunwale edges so as to fold inwardly and outwardly in concertina fashion. A collapsible bulkhead member extends in sealed relationship between each inwardly folding pair of hull members. The bulkhead and hull head define a sequence of parallel hulls when the pontoon is extended. The bulkhead members may comprise a flexible membrane, which folds between the hull members when they are closed. Alternatively, each bulkhead member may comprise a centrally articulated pair of plates, hinged at their outer edges to the associated hull members so as to fold inwards when the pontoon is folded. Gunwale spacing beams are provided to stabilize the opened pontoon and to provide trackways. (Cremmins-AEPCO)
W88-04777

MARINE TRANSFER DEVICE,
Boeing Co., Seattle, WA.
J. W. Williams.
U. S. Patent No. 4,590,634; May 27, 1986, 11 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1066, No 4, p 1567, May 27, 1984.

Descriptors: *Patents, *Offshore platforms, *Ships, *Transportation, Construction methods, Ramps, Personnel.

A marine device, consisting of a ramp, a walkway, and sides, transfers personnel or material between an offshore platform and a moving object, such as a ship, with relative safety and efficiency. The inboard end of the ramp is hinged to the platform to allow the ramp to swing both vertically and horizontally. The ramp is moved by a service derrick or crane so that its outboard end is positioned near the deck of the ship. A frame, which is pivotally connected to the outboard end of the ramp, extends below the walkway of the ramp and is connected by a ball and socket joint to an inflated landing pad. The ramp is lowered by the service derrick so that the landing pad rests on the deck of the ship. The frame and landing pad thereby support the outboard ends and a floor extends from the outboard end of the ramp toward the deck of the ship. The outboard end of the carriage assembly is attached to the frame. Stairs extend downward to the surface of the ship's deck from the portion of the frame that is connected to the carriage. (Cremmins-AEPCO)
W88-04778

TENSION LEG PLATFORM WITH HORIZONTAL MOVEMENT CAPABILITY,
Chevron Research Co., San Franciso, CA.
P. M. Aagaard.
U. S. Patent No. 4,423,985; January 3, 1984. 5 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1038, No 1, p 169, January 3, 1984.

Descriptors: *Patents, *Offshore platforms, *Flotation, *Buoyancy, *Drilling equipment, Oil fields, Tension, Conduits, Flexibility, Anchors.

An offshore tension leg drilling platform contains a floating buoyant structure anchored to the sea floor by flexibe tendons. Flexible lines are connected between the structure and the anchored tendons. This connection permits the structure to move substantially in a horizontal plane from the original anchor site within the scope of the flexible lines. The flexible lines, which are stored in reels on the platform deck, pass vertically through a conduit housed in each buoyant chamber leg to the upper end of the flexible tendons. The anchored tendons are disconnected from the buoyant legs and the flexible lines are payed out, permitting the structure to be moved in a horizontal plane from its normal operating position. (Cremmins-AEPCO)
W88-04779

AMPHIBIOUS VEHICLE THAT CAN BE USED AS AN INDEPENDENT FERRY AND ABLE TO FORM A PONTOON BRIDGE,
Chaudronnerie et Forges d'Alsace, Soultz-sous-Forets (France).
J. Gillois.
U. S. Patent No. 4,621,385; November 11, 1986. 10 p, 13 fig. Official Gazette of the United States Patent Office, Vol 1072, No 2, p 411-412, November 11, 1986.

Descriptors: *Patents, *Pontoons, *Bridges, *Bridge construction, *Ferries, Construction methods, Flotation, Transportation.

An amphibious vehicle comprising a hull equipped with retractable wheel and inflatable longitudinal lateral floats can be used as a ferry or a pontoon bridge. On the front walls of the vehicle, two series of ramps in a folded position rest on the

upper wall of the hull, and in an unfolded position extend it. Each lateral float associated with the hull has in its inflated position a length corresponding to the length of the hull; while each of the hinged flaps, which are connected with the floats and occupy a horizontal position extending the upper wall of the hull in the inflated position of the floats, has a length slightly less than that of the hull. Thus, each float becomes an elastic wall system between the hull and the corresponding flap when deflated. When the flaps are in their folded position, the end portholes placed in the lateral walls are freed to allow lateral visibility. Each ramp section, which is hinged at one end of the hull and has a width corresponding to the width of the hull, is equipped with two inflatable longitudinal and lateral floats of a length corresponding to that of the ramp section, so as to rest on the corresponding lateral float of the hull. The lateral ramp floats are retractable in the deflated position between a flap and the ramp section. (Cremmins-AEPCO)
W88-04780

PRESTRESSED CONCRETE STRUCTURE, A METHOD OF PRODUCING THIS STRUCTURE, AND ELEMENTS FOR IMPLEMENTING THE METHOD,
Bouygues S.A., Clamart (France).
For primary bibliographic entry see Field 8F.
W88-04781

SUSPENSION BRIDGE,
D. R. Webster.
U. S. Patent No. 4,535,498; August 20, 1985. 11 p, 9 fig. Official Gazette of the United States Patent Office, Vol 1057, No 3, p 993, August 20, 1985.

Descriptors: *Patents, *Bridges, *Bridge construction, *Suspension, Construction methods, Transportation, Piers.

A suspension bridge is constructed using incline spars or booms in place of towers and piers. The spars or booms lean from the shore and over the water to points corresponding to tower tops. A first system supports the lean of the spars. A second system supports a length of deck centered under the spar tops; half the deck length extending to the spar base at the shore, the other half, a counter-weight, extends oppositely an equal distance beyond the spar top. This second system accordingly supports a deck portion near the shore, suspended by several inclined hangers from the spar tops. A third system supports the deck at mid span lying between the extremities of the second system at both shores. Oscillation of the deck is dampened by overlapping the suspension systems. (Cremmins-AEPCO)
W88-04782

ICE BARRIER FOR ISLANDS,
Atlantic Richfield Co., Los Angeles, CA.
For primary bibliographic entry see Field 2C.
W88-04783

ICE ISLAND CONSTRUCTION,
Standard Oil Co., Chicago, IL.
G. F. N. Cox, and F. H. Hsu.
U. S. Patent No. 4,373,836; February 15, 1983, 10 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1027, No 3, p 1073-1074, February 15, 1983.

Descriptors: *Patents, *Ice formation, *Oil industry, *Construction methods, *Sea ice, *Freezing, Ice-brine systems, Deflection, Islands, Ice sheets, Trenches.

An artificial ice island is constructed in a marine body of water covered by natural sheet ice in subfreezing temperatures. Blocks from the ice sheet are mined then cooled by stacking or storing them so that they contact the air. The blocks are stacked directly on top of the sheet ice without building up a lower level by normal flooding and freezing. A small rectangular shaped island section is constructed by stacking blocks on an area small enough so that the natural ice does not fail if a trench is cut through the ice sheet around the section. Additional sections are built until the desired size of the island is obtained. In another form, a ring of blocks is constructed. The interior of the ring is filled systematically to minimize the deflection of the ice sheet inside the ring. A ring is cut around the selected area to separate the ice island from the surrounding ice to eliminate or prevent deflections as the area is sunk by the weight of the blocks. (Cremmins-AEPCO)
W88-04804

PILING ENCASEMENT SYSTEM,
Sonoco Products Co., Hartsville, SC.
L. W. Roper.
U. S. Patent No. 4,439,071; March 27, 1984, 6 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1040, No 4, p 1581, March 27, 1984.

Descriptors: *Patents, *Piles, *Concrete construction, *Construction methods, Rigid foundations, Tubes, Casings.

A mold outwardly encircles a marine pile to form a reinforcing sleeve of concrete or the like about the pile. The mold comprises a first integral one-piece section of partial tubular configuration and an independent second integral one-piece section, also of partial tubular configuration. The first section extends about an arc of greater than 180 degrees and has opposed longitudinal edges defining an opening of an arc of less than 180 degrees. The second section extends about an arc greater than that of the opening for positioning over the opening. The first section includes an outer surface and the second section terminates in opposed edges positioned in overlying relation to the outer surface of the first section circumferentially spaced from the opening beyond the opposed edges of the opening. The opposed edges of the second section are directly supported by the first section. (Cremmins-AEPCO)
W88-04824

SARTIGAN DAM IN BEAUCE (QUEBEC) CANADA: AN EXAMPLE OF DETERIORATION RESULTING FROM ALKALI-AGGREGATE REACTIVITY (LE BARRAGE SARTIGAN DANS LA BEAUCE (QUEBEC), CANADA: UN CAS-TYPE DE DETERIORATION DU BETON PAR DES REACTIONS ALCALIS-GRANULATS),
Laval Univ., Quebec.
For primary bibliographic entry see Field 8F.
W88-04868

ANALYSIS OF GRADUAL EARTH-DAM FAILURE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W88-05074

8B. Hydraulics

DESIGN OF INLET/OUTLET WORKS FOR PUMP TURBINES,
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau.
For primary bibliographic entry see Field 8C.
W88-04534

WATER DISTRIBUTION WITHOUT STORAGE,
Keizer City Water Dept., OR.
For primary bibliographic entry see Field 5F.
W88-04875

APPLICABILITY OF THEORETICAL EXPRESSIONS FOR FLOW RATE INTO PERFORATED DRAINTUBES,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W88-05046

TURBULENCE MEASUREMENTS IN SMOOTH AND ROUGH-WALLED TRAPEZOIDAL DUCTS,
Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.
P. Prinos, S. Tavoularis, and R. Townsend.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 1, p 43-53, January 1988. 11 fig, 10 ref, append.

Descriptors: *Hydraulics, *Turbulent flow, *Rivers, *Flow, Flow patterns, Closed-conduit flow, Ice cover, Roughness coefficient, Channel flow, Shear stress, Open-channel flow.

Turbulent air flow was studied in a trapezoidal duct with both hydraulically smooth and partly roughened walls. The results of this study can be helpful in examining the hydraulics of ice-covered rivers and open channels. The duct had a mean aspect ratio of 3.5 and corner angles of 64 and 116 degrees. Measurements in the fully developed flow region included wall shear stress and isocontours of the axial mean velocity, the normal and shearing turbulent stresses, and the turbulent kinetic energy. The contours were compatible with strong secondary currents, which were approximately symmetric about the bisectors of corner angles between two smooth walls. The measurements demonstrated that simple gradient transport models, which represent flow in circular pipes reasonably well, would be inadequate for the modeling of both smooth and partly-roughened trapezoidal duct flows. (Cassar-PTT)
W88-05075

UNCERTAINTY IN SUSPENDED SEDIMENT TRANSPORT CURVES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W88-05077

8C. Hydraulic Machinery

TRENCHLESS SEWER-LAYING: MOLES AND PLASTIC SAVE TIME AND TROUBLE,
S. Wallis.
Water Resources Journal, No. 152, p 46-47, March 1987.

Descriptors: *Sewers, *Hydraulic machinery, *Moles, *Pipelines, Pipes, Water conveyance, Pneumatic equipment, Costs.

Thousands of kilometers of small diameter pipeline run through every major city, town and community, carrying water and gas to buildings and taking waste matter away. Until recently, the only way to provide these services was to dig trenches along the streets, lay the pipe and backfill the hole. Subsequent repairs entailed excavating the trench again. A British development which avoids closing main streets for the open trench method is a technique whereby old, deteriorated or under-capacity pipes up to 510 mm internal diameter are burst from inside and a new pipe laid in their place. At the heart of the system is a pneumatically operated percussive mole, known as a pipeline insertion machine (PIM), capable of shattering cast iron, clay or concrete pipes and forcing the fragments into the surrounding soil. This creates a passage through which the machine guides a replacement pipeline of similar or greater diameter. There are two different equipment packages, one of cast iron pressure pipes carrying water, gas and sewage, and another for non-pressure sewage pipes. The mole is powered by compressed air supplied via a hose threaded through the pipe and connected to a compressor on the surface. Towing the pipe, it passes through the section at up to 2.5 m/min. Sections of up to 100 m can be replaced from one launch pit in one working day. Initially, existing pipes were replaced with pipes of the same diameter. However, with the power to burst cast iron pipes of up to 150 mm in diameter, it is possible to provide a passage for a new pipe some 180% larger than the existing one. Over 500 km of cast iron gas pipeline have been replaced for British

Gas in the past two years with an average 20% reduction in relaying costs. (Lantz-PTT)
W88-04514

VIBRATION MONITORING OF HYDRO MACHINERY,
Vibro-Metro S.A., Fribourg (Switzerland).
G. Chevroulet.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 10, p 27-28, October 1987. 3 fig.

Descriptors: *Hydraulic machinery, *Monitoring, *Vibrations, Turbines, Hydraulic equipment, Hydraulic turbines.

Within the context of the maintenance of hydro installations, the application of vibration monitoring and analysis systems on turbo-generator sets is becoming more and more important. Possibilities are available for measuring the following vibration parameters: relative vibration of the shaft; absolute vibration of the bearing; absolute vibration of the shaft (in special cases); and, absolute vibration of structures. The characteristics and applications of the different ways of measuring these vibrations are outlined. The vibratory behavior of a machine is influenced by the evolution of a number of different parameters. It is therefore imperative to proceed with the correlation of the vibration parameter with other characteristics such as: speed (phase reference for the harmonic analysis); axial position of the shafts; differential expansion; temperature of bearings; position of control devices; generator (alternator) gap (static and dynamic); head; and, power output. (Lantz-PTT)
W88-04533

DESIGN OF INLET/OUTLET WORKS FOR PUMP TURBINES,
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau.
H. Els.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 10, p 33-37, October 1987. 6 fig, 1 tab, 10 ref.

Descriptors: *Inlets, *Outlets, *Turbines, *Hydraulic machinery, *Hydraulic profiles, Hydraulic models, Model studies, Flow profiles, Pumps, Conduits.

Hydraulic machines in a shaft must be connected with an S-shaped conduit. But this shape induces non-uniformities and fluctuations in flow, which can cause early damage and shut-down. Based on model studies, hydraulic design criteria are presented to find an optimum shape for an inlet/outlet structure for a turbine, a pump, or a pump turbine in a shaft. To ensure efficiency and prolong operating life, the design of the outlet work is very important. These conduits must ensure that appropriate conditions for the flow approaching a pump are provided: for a turbine, they must provide a high pressure recovery and calm, smooth flow at the outlet. The conduit of a pump-turbine in a shaft must be a combination of both. (Lantz-PTT)
W88-04534

HYDRO TURBINE REFURBISHMENT,
Sorumsand Verksted A/S (Norway).
P. Ligaard.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 10, p 37-40, October 1987. 4 fig, 5 tab.

Descriptors: *Hydraulic equipment, *Turbines, *Hydraulic turbines, *Maintenance, Norway, Hydroelectric power, Design standards.

Norway's electricity consumption is almost entirely based on hydropower, as a result of both the climate and topography. In 1920, approximately 2500 hydropower plants were in operation. However, the major hydro development took place between 1960 and 1970. As a result, only 10% of Norway's existing plants are more than 50 years old, with 70% less than 25 years old. Kvaerner Brug A/S of Oslo has played an important part in the development of Norwegian hydropower, having designed and manufactured turbines for most of Norway's 25 GW of installed hydro capacity. During the last 30 years Sorumsand Verksted A/S (a member of the Kvaerner group) has specialized in refurbishment activities. New technology for refurbishment and project categories (refurbishment in the workshop, refurbishment on site, replacement based on original design, and replacement based on new improved design) are described, as well as examples of each project category. (Lantz-PTT)
W88-04535

OPTIONS FOR REFURBISHMENT: THREE CASE STUDIES IN ITALY,
M. Gebendinger.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 10, p 45-47, October 1987. 3 fig.

Descriptors: *Hydroelectric powerplants, *Italy, *Maintenance, *Refurbishing, Case studies, Hydraulic equipment, Hydraulic machinery.

Three case studies of Italian hydro plants which were refurbished in different ways are taken as examples to demonstrate that a variety of options for uprating exist. The case studies described, illustrate the various ways of doing this: For Ninfa (a small village between Rome and Naples), the only adequate solution was a new turbine-generator set, which allowed a general modification of the plant from the dam to the tailwater; For Bardi, better guidevanes and new runners were sufficient; and For Venina (part of the privately owned Valtellina power complexes), the priority was improvement of frequency stability in isolated operation, and a quicker startup time for the machine. Design and engineering problems relating to these schemes are discussed and the author addresses two basic points: whether uprating is always possible; and, how far uprating should go. (Lantz-PTT)
W88-04536

OVERVIEW OF SMALL HYDRO DEVELOPMENT IN CANADA,
R. H. Clark, and T. Tung.
International Water Power and Dam Construction, Vol. 39, No. 9, p 15-20, September 1987. 3 fig, 6 ref.

Descriptors: *Hydroelectric plants, *Water resources development, *Canada, Evaluations, Economic aspects, Energy, History.

Small hydro developments have many advantages over all other energy options, particularly for the growth of northern communities in Canada, where it could provide a dependable and economic energy supply. The history of hydropower development in Canada is reviewed focusing particularly on the resurgence of interest in small-scale schemes in recent years. Scope for further technical innovation is discussed, and constraints which have hampered small hydro development are outlined. (Author's abstract)
W88-04537

POWERHOUSE RESTORATION USING F.E.M. MODELLING,
Beck (R.W.) and Associates, Seattle, WA.
For primary bibliographic entry see Field 8A.
W88-04540

MICRO HYDRO SCHEMES IN PAPUA NEW GUINEA,
Edinburgh Univ. (Scotland). Dept. of Electrical Engineering.
K. Whittaker, H. W. Whittington, and D. E. Macpherson.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 12, p 21-24, December 1987. 5 fig, 10 ref.

Descriptors: *Papua New Guinea, *Hydroelectric power, *Water resources development, Management planning, Electric powerplants, Case studies.

Papua New Guinea has abundant small-scale hydropower resources. The rugged terrain and tropical rainfall pattern of the country means that the hydropower is a key candidate for development. As a result, the government is replacing diesel generating units with mini and micro hydropower plants to serve remote centers. Most of the existing micro hydro schemes have been developed outside the public sector. Two case studies (Tari and Yagusa) are presented here, and an attempt has been made to identify the key factors that led to the relative difference in costs. Among the factors explaining the lower cost at Yagusa are: (1) high head, minimizing civil works; (2) significant use of used equipment; (3) limited land compensation costs; (4) labor-intensive construction, using mostly volunteers; (5) a lower standard of engineering was considered acceptable; and (6) output is considerably restricted by lack of water for up to 3 months annually. (Author's abstract)
W88-04578

WYANGALA HYDRO PROJECT IN AUSTRALIA,
Camp Scott Furphy Pty Ltd., Melbourne (Australia).
P. Van der Riet.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 12, p 31-35, December 1987. 6 fig, 3 tab.

Descriptors: *Hydroelectric power, *Australia, *Wyangala dam, *Water resources development, *Rockfill dams, *Feasibility studies, Dams, Hydraulic structures, Electric powerplants, Floods, Francis turbines, Submerged powerhouse.

The Wyangala dam, a rockfill structure with a clay core, was designed and built by the New South Wales Department of Water Resources (DWR) in 1971, to regulate the flow of the Lachlan River for irrigation. Located about 30 km upstream of the town of Cowra, it replaced an old gravity dam which had been in operation since 1936. The proposed 13 MW Wyangala hydropower project would be downstream of the 86 m-high Wyangala dam. The surface power station will contain two 6.5 MW horizontal shaft Francis turbines coupled to a single 14 MVA generator. The powerhouse may be designed for complete submergence during very large floods. This article describes a feasibility study which shows that the construction of the hydropower station would be technically feasible and economically attractive to the South West Slopes County Council, which has decided to seek permission to build. The station could be in operation by mid-1990. (Lantz-PTT)
W88-04579

BURDEKIN FALLS DAM,
Queensland Water Resources Commission, Brisbane (Australia).
For primary bibliographic entry see Field 8A.
W88-04580

SELF-SUSTAINING LAND IRRIGATING AND HYDROELECTRIC POWER GENERATING SYSTEM,
For primary bibliographic entry see Field 3F.
W88-04787

HYDRAULIC HORIZONTAL MIXER,
Air-O-Lator Corp., Kansas City, MO.
For primary bibliographic entry see Field 5D.
W88-04806

SEQUENCING VALVE AND IRRIGATION,
For primary bibliographic entry see Field 3F.
W88-04836

MULTI-LAYERED CORRUGATED CONDUIT WITH 'BLACK-EYE' LIKE APERTURES,
Hancor, Inc., Findlay, OH.
For primary bibliographic entry see Field 4A.
W88-04837

AUTOMATIC CONTROL OF CANAL FLOW USING LINEAR QUADRATIC REGULATOR THEORY,
O. S. Balogun, and J. J. DeVries.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 1, p 75-103, January 1988. 12 fig, 26 ref, append. California Water Resources Center Project W-676 grant.

Descriptors: *Hydraulic machinery, *Hydraulics, *Channel flow, *Canals, *Automation, *Flow, Linear quadratic regular theory, Open channel flow, Gates, Irrigation canals, Hydrodynamics, Pumping, Costs.

An integrated approach to the design of automatic control systems for canals using Linear Quadratic Regulator theory was developed. The one-dimensional partial differential equations describing open channel flow (Saint-Venant equations) were linearized about equilibrium flow conditions and discretized spatially to provide a set of approximate ordinary differential equations which describe the effects of gate openings on depth and flow rate. Standard linear quadratic techniques were used to design a regulator. The requirement to measure all states is obviated by the construction of an observer using only measurements of depth adjacent to control gates. Simulation results showed dramatic improvements in transient response over the uncontrolled case. Use of these techniques in water conveyance canals facilitates more rapid changes in discharge, and by permitting longer periods of off-peak pumping, could greatly reduce pumping costs. (Author's abstract)
W88-05078

8D. Soil Mechanics

STATE FUNDED DAM AND RECREATION AREA TAKES CARE OF ENVIRONMENT AND HISTORY,
Kennedy/Jenks/Chilton, San Francisco, CA.
For primary bibliographic entry see Field 6G.
W88-04872

UNDRAINED SHEAR STRENGTH FROM PIEZOCONE TESTS,
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
J.-M Konrad, and K. T. Law.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 3, p 392-405, August 1987. 18 fig, 3 tab, 48 ref.

Descriptors: *Soil mechanics, *Measuring instruments, *Strength, *Penetrometers, *Pore pressure, Piezocone penetrometer, Cone penetrometers, Rigidity index, Clays, Pressure-measuring instruments.

With the advent of piezocones--penetrometers measuring both the mechanical resistance and induced pore pressures near the tip during penetration into the soil--a new interpretation of penetrometer test data is possible. Available interpretation methods for obtaining the undrained shear strength of soft soils are reviewed and a new interpretation taking into account measured pore pressures is introduced. The undrained shear strength is considered to be solely related to the ultimate cavity expansion pressure, which is one of the components of the tip resistance. The other component is calculated assuming that effective friction is developed at the cone-soil interface. Parametric studies on the parameters required for strength determination based on the proposed method are also presented. Special self-boring pressuremeter tests to obtain relevant values of soil rigidity index, which is a key parameter for cavity expansion modelling, are described. Tests were conducted at three sites having the characteristics of soft sensitive clay, stiff sensitive clay, and clayey silt. The operational undrained strength mobilized during the cone insertion derived from the proposed model is equal to or lower than the CK sub 0 U triaxial strength, which depends on soil brittleness. The proposed approach yields results consistent with known soil behavior at all three sites. (Author's abstract)
W88-05055

ANALYSIS OF GRADUAL EARTH-DAM FAILURE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and P. D. Scarlatos.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 1, p 21-42, January 1988. 7 fig, 5 tab, 23 ref, append. U. S. Army Engineer Waterways Experiment Station, Environmental Laboratory, through Battelle Columbus Laboratories, Contract No. DAAG 29-81-D-0100.

Descriptors: *Soil mechanics, *Hydraulic structures, *Dam failure, *Erosion, *Earth dams, Model studies, Mathematical models, Breach erosion, Soil erosion, Teton Dam, Idaho, Hydrographs.

Analytical models were developed to simulate earth-dam breach erosion for three types of breaches: rectangular, triangular, and trapezoidal. Breach erosion was assumed to be either a linear or quadratic function of the outflow mean water velocity. All of the models satisfactorily simulated the outflow discharge produced during the failure of Teton Dam in Idaho. The rectangular breach models were more accurate than the triangular breach models in this specific case. The linear erosion models better represented the recession hydrograph limb, while the nonlinear erosion models better approximated the rising limb. Increased values of discharge coefficient, erosivity coefficient, bottom width of breach, breach side slope, and surface area of storage water produced an increase in the outflow maximum discharge, while decrease in the same quantities resulted in reduction of the maximum discharge. Results were almost insensitive to the initial hydraulic head but were strongly dependent on the value of the erosivity coefficient. Linear erosion models generally performed better than nonlinear erosion models. (Cassar-PTT)
W88-05074

8E. Rock Mechanics and Geology

NEW ZEALAND'S CLYDE POWER STATION,
Ministry of Works and Development, Wellington (New Zealand).
J. W. Hatton, J. C. Black, and P. F. Foster.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 12, p 15-20, December 1987. 9 fig, 2 tab, 3 ref.

Descriptors: *New Zealand, *Clyde Dam, *Concrete dams, *Powerplants, Clutha River, Geologic fractures, Hydraulic structures, Dams, Spillways, Landslides, Earthquakes.

A 100 m-high concrete gravity dam for the generation of 432 MW of power is under construction at Clyde on the Clutha river in the South Island of New Zealand. Clyde dam will control the Clutha river at the exit of the Cromwell Gorge, which is at the southern end of the Dunstan Mountain range. A feature of the dam is the provision of a slip joint to allow up to 2 m of movement on the plane of this fault passing through the dam foundation. The nearest active segment of the fault is 3-9 km northwest of the dam site. A major rupture of the fault is estimated to be capable of producing an earthquake of magnitude 7 to 7.5 on the Richter scale. The average frequency for such an earthquake is estimated to be 8500 years. The maximum credible earthquake at the dam site is based on a rupture of the Dunstan fault. The discussion further focuses on: dam foundations; seismic design; mass concrete; asphalt seals; spillways and stilling basins; the powerhouse; dewatering sluices; and landslides. (Lantz-PTT)
W88-04577

ANIWHENUA HYDROELECTRIC SCHEME,
Tonkin and Taylor Ltd., Auckland (New Zealand).
For primary bibliographic entry see Field 8A.
W88-04581

EFFECT OF URANIUM SITING IN TWO-MICA GRANITES ON URANIUM CONCENTRATIONS AND RADON ACTIVITY IN GROUND WATER,
Shevenell Gallen and Associates, Inc., Portsmouth, NH.
For primary bibliographic entry see Field 5B.
W88-04983

DETERMINATION OF BULK RADON EMANATION RATES BY HIGH RESOLUTION GAMMA-RAY SPECTROSCOPY,
Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W88-04988

RADON-222 CONCENTRATION OF GROUNDWATER FROM A TEST ZONE OF A SHALLOW ALLUVIAL AQUIFER IN THE SANTA CLARA VALLEY, CALIFORNIA,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-04993

FIELD METHOD FOR THE DETERMINATION OF ROCK-MASS MODULUS,
University of Western Ontario, London. Faculty of Engineering Science.
K. Y. Lo, T. C. B. Yung, and B. Lukajic.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 3, p 406-413, August 1987. 8 fig, 2 tab, 7 ref. Natural Sciences and Engineering Research Council of Canada Grant A7745.

Descriptors: *Dam design, *Rock mechanics, *Rock properties, *Mass modulus, Shear tests, Deformation, Field tests, Underground structures, Stress analysis.

A field test for measuring rock modulus was developed and performed in shaly limestone at the Darlington Generating Station, Ontario. Six perimeter holes, 75-mm in diameter, were drilled in a rosette pattern into the rock mass. Measuring posts were grouted into these holes and the position of each pair recorded before and after the drilling of a 150-mm diameter central hole which relieved the in situ stresses. Results were consistent with those from extensometer measurements in the tunnels. A complementary laboratory program to study the effect of specimen size on the elastic parameter was performed by using compressional and shear wave velocity measurements. In the vertical direction the dynamic shear, Young's modulus, and the Poisson's ratio were essentially independent of size within a range of relatively small specimen dimensions. Beyond this threshold the Poisson's ratio increased with increase in specimen volume from 0.36 to about 0.5. The dynamic shear modulus decreased from 10 to about 3 GPa. Young's modulus similarly decreased with increase in size. In the horizontal direction a similar trend of change in modulus may be expected. (Cassar-PTT)
W88-05056

8F. Concrete

METHOD OF AND STRUCTURE FOR ERECTING AN ARTIFICIAL ISLAND,
Dyckerhoff und Widmann A.G., Munich (Germany, F.R.
For primary bibliographic entry see Field 8A.
W88-04767

ARCTIC CAISSON SYSTEM,
Watt (Brian) Associates, Inc., Houston, TX.
For primary bibliographic entry see Field 8A.
W88-04768

BARGE HULL FOR OFFSHORE DRILLING RIGS,
Marathon Mfg. Co., Houston, TX.
For primary bibliographic entry see Field 8A.
W88-04770

PRESTRESSED CONCRETE STRUCTURE, A METHOD OF PRODUCING THIS STRUCTURE, AND ELEMENTS FOR IMPLEMENTING THE METHOD,
Bouygues S.A., Clamart (France).
P. Richard.
U. S. Patent No. 4,620,400; November 4, 1986. 15 p, 17 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1072, No 1, p 41, November 4, 1986.

Descriptors: *Patents, *Concrete construction, *Bridge construction, *Prestressed concrete, Bridges, Reinforced concrete, Construction methods.

Two reinforced or prestressed concrete slabs used for the construction of bridges are positioned opposite each other and are connected by a lattice work of reinforced or prestressed concrete positioned in the volume between the slabs. The lattice work is composed of prefabricated elements comprising at least one group of at least two bars and at least one cross piece which are positioned along the three sides of a triangle. The meeting point of the two bars forms the apex of the triangle. Prestressing cables of the structure are anchored at their ends in concrete solid masses positioned between the slabs and integral with at least one of the slabs. The cables pass inside the volume and/or in the vicinity of the slabs and remain outside the concrete of the lattice work. (Cremmins-AEPCO)
W88-04781

PILING ENCASEMENT SYSTEM,
Sonoco Products Co., Hartsville, SC.
For primary bibliographic entry see Field 8A.
W88-04824

METHOD OF PREPARING CONCRETE COLUMN FOR ATTACHMENT TO BEAM,
A. L. Destree.
U. S. Patent No. 4,327,703; May 4, 1982, 7 p, 8 fig. Official Gazette of the United States Patent Office, Vol 1018, No 1, p 96, May 4, 1982.

Descriptors: *Patents, *Construction methods, *Concrete construction, *Piers, *Reinforced concrete.

The end of a concrete column for supporting piers, buildings and other structures is treated to ensure a secure engagement with a cast-in-place beam supported by the column. After its elevation is established, the finished column is cut at a location above that elevation sufficient to provide the length of reinforcing elements necessary to tie into the beam or floor which the column will support. An axially disposed hole extending inside the column to the chosen elevation is bored using an abrasive core drill. The column is scored at the predetermined elevation using an abrasive saw. The scoring extends into the column to a depth that is insufficient to cut or otherwise damage the reinforcing elements imbedded in the column. The column is scored completely around its periphery to control and prevent spalling of the concrete during the preparation steps which follow. The hollow cylindrical concrete portion of the column above the chosen elevation is then crushed by sledgehammer blows or in the jaws of a crusher until the concrete is removed, exposing the reinforcing bars or cables. The exposed reinforcing elements are then bent down into the position in which they will be cast within the beam or floor to be supported by the column. (Cremmins-AEPCO)
W88-04830

TESTING OF ZERO-SLUMP PILING CONCRETE,
Klohn Leonoff Ltd., Calgary (Alberta).
L. E. Rodway.
Canadian Journal of Civil Engineering CJCEB, Vol. 14, No. 3, p 308-313, June 1987. 3 fig, 5 tab, 9 ref.

Descriptors: *Concrete testing, *Piles, Proctor hammer, Energy, Vibration, Compaction, Concrete technology.

A laboratory and field study was conducted to develop a practical test method that would realistically predict the appropriate concrete strength to be used in the calculation of the structural load-carrying capacity of this type of pile. Theoretical considerations also are discussed. It is concluded that the most practical way to predict the strength of zero-slump piling concrete accurately is to use a modified Proctor hammer weighing 4.5 kg, dropping 457 mm. To obtain an approximation of the energy imparted in the field to the shafts of actual piles a standard heavy wall hollow steel cylinder mold was filled in 6 layers, using hand compaction, at 45 blows/layer. This casting procedure was followed by standard moist curing for 28 days prior to testing in compression. This method is referred to as the KL test method for evaluation of zero-slump piling concrete. (Rochester-PTT)
W88-04865

SARTIGAN DAM IN BEAUCE (QUEBEC) CANADA: AN EXAMPLE OF DETERIORATION RESULTING FROM ALKALI-AGGREGATE REACTIVITY (LE BARRAGE SARTIGAN DANS LA BEAUCE (QUEBEC), CANADA: UN CAS-TYPE DE DETERIORATION DU BETON PAR DES REACTIONS ALCALIS-GRANULATS),
Laval Univ., Quebec.
M. A . Berube and, and B. Fournier.
Canadian Journal of Civil Engineering CJCEB, Vol. 14, No. 3, p 372-380, June 1987. 4 fig, 31 ref.

Descriptors: *Concrete dams, *Deterioration, *Sartigan dam, Alkali-aggregate reactivity, Wetting, Rhyolites, Quartz, Weathering, Concrete technology, Chaudiere River.

The Sartigan dam, a concrete ice-retention dam, built in 1967 along the Chaudiere River, near Saint-George de Beauce, Quebec, Canada, shows numerous macroscopic and microscopic signs of alkali-aggregate reactivity of the alkali-silica type (e.g., expansion, polygonal map cracking, silico-alkaline gels, looseness of cement paste-aggregate bonds, and characteristic rims on fracture surfaces through coarse reactive aggregate particles). The three conditions considered essential to promote alkali-aggregate reactions have been satisfied in this case: (1) the use of high-alkali cement, (2) conditions of high humidity, reinforced by frequent wetting-drying cycles, and (3) aggregates considered as potentially alkali-reactive present in the concrete (rhyolitic tuffs with a devitrified matrix rich in microcrystalline quartz). (Author's abstract)
W88-04868

8G. Materials

TESTING OF ZERO-SLUMP PILING CONCRETE,
Klohn Leonoff Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 8F.
W88-04865

ECONOMIC IMPACT OF PAVEMENT SUBSURFACE DRAINAGE,
California State Dept. of Transportation, Sacramento. Office of Transportation Lab.
R. A. Forsyth, G. K. Wells, and J.H. Woodstrom.
Public Works PUOAH, Vol. 119, No. 1, p 61-64, 88, January 1988. 2 fig.

Descriptors: *Paving, *Drainage engineering, *Cost analysis, Highways, California, Geotextiles, Asphalt, Flexible pavement.

The history of paving, performance of undrained pavements, and road test results are reviewed, and recent developments in subsurface drainage of pavements are described. Milestones in the evolution of better subsurface drainage include geotextiles, asphalt-treated permeable materials, and PCC pavement edge drains. Case histories of rigid pavement and flexible pavement installations are reviewed, with emphasis on experience in California. Attempting to quantify the economic impact of positive rapid pavement drainage is difficult for many reasons. Based on what they consider to be extremely conservative assumptions, the authors suggest that case histories suggest a minimum increase of four years in service life for a drained system employing flexible pavement; for a rigid pavement studies suggest a minimum 50% extension of the service life of PCC pavements with an efficient, functioning edge drain system. Results of a cost analysis are presented in terms of cost/sq yd per year from construction until first rehabilitation. (Rochester-PTT)
W88-04877

ADFREEZING STRENGTH OF ICE TO MODEL PILES,
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
For primary bibliographic entry see Field 2C.
W88-05057

8I. Fisheries Engineering

INTERNATIONAL SYMPOSIUM ON THE MOST IMPORTANT UPWELLING AREAS OF WESTERN AFRICA (CAPE BLANCO AND BENGUELA)(SIMPOSIO INTERNACIONAL SOBRE LAS AREAS DE AFLORAMIENTO MAS IMPORTANTES DEL OESTE AFRICANO (CABO BLANCO Y BENGUELA)).
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
For primary bibliographic entry see Field 2L.
W88-04709

DEMERSAL COMMUNITIES STRUCTURE (FISHES) IN THE UPWELLING AREAS OFF WESTERN AFRICA (SAHARA AND NAMIBIA)(LAS COMUNIDADES DE PECES DEMERSALES DEL AFLORAMIENTO DE AFRICA OCCIDENTAL (SAHARA Y NAMIBIA)),
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
For primary bibliographic entry see Field 2L.
W88-04713

SPECIES INTERACTIONS AND STOCK ASSESSMENT. SOME IDEAS AND APPROACHES,
Food and Agriculture Organization of the United Nations, Rome (Italy).
For primary bibliographic entry see Field 2L.
W88-04714

CEPHALOPOD FISHERIES IN TWO UPWELLING AREAS OFF THE WEST COAST OF AFRICA: A COMPARISON (COMPARACION DE LAS PESQUERIAS DE CEFALOPODOS DE DOS AREAS DE AFLORAMIENTO DE LA COSTA OCCIDENTAL AFRICANA),
Instituto de Investigacones Pesqueras de Vigo (Spain).
For primary bibliographic entry see Field 2L.
W88-04715

FISHERY RESOURCES OF THE UPWELLING AREA OFF NW AFRICA (LOS RECURSOS PESQUEROS DEL AREA DE AFLORAMIENTO DEL NO AFRICANO),
Instituto Espanol de Oceanographia, Tenerife (Spain). Centro Costero de Canarias.
For primary bibliographic entry see Field 2L.
W88-04716

LIVING RESOURCES OF THE BENGUELA CURRENT REGION,
Sea Fisheries Research Inst., Cape Town (South Africa).
For primary bibliographic entry see Field 2L.
W88-04718

OBSERVATIONS ON SPATIAL DISTRIBUTION OF HORSE MACKEREL IN ICSEAF DIVISION 1.3 (OBSERVACIONES SOBRE LA

DISTRIBUCION ESPACIAL DEL JUREL EN LA DIVISION 1.3 DE ICSEAF),
Institute of Marine Fisheries, Swinojscie (Poland).
For primary bibliographic entry see Field 2L.
W88-04719

SOLE FISHERY OFF THE ORANGE RIVER, SOUTHERN AFRICA,
Sea Fisheries Research Inst., Cape Town (South Africa).
For primary bibliographic entry see Field 2L.
W88-04720

ZEOLITE AMMONIA REMOVAL FROM CATFISH POND WATERS,
Mississippi Univ., University. Dept. of Geology and Geological Engineering.
For primary bibliographic entry see Field 5D.
W88-04755

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1986 PROGRAM REPORT (KENTUCKY WATER RESOURCES RESEARCH INSTITUTE),
Kentucky Water Resources Research Inst., Lexington.
D. T. Kao.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128103/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report No. G1227-01, July 1987. 31 p. Contract No. 14-08-0001-G1227. Project No. USGS G1227-01.

Descriptors: *Water Research Institute, *Kentucky, *Research, *Information transfer, *Training, Watershed management, Anaerobic digestion, Phenols, Aluminum, Soil chemistry, Herbicides, Aquatic life, Aquatic populations.

The Annual Report of the Kentucky Water Resources Research Institute for Fiscal Year 1986 describes the problems and issues for the Commonwealth's water resources. The program goals and priorities describe the areas of water resources research the 1986-1987 program addresses. A synopsis of each of the five research projects funded is included. The five projects are: 02, Development of Dynamic, Non-Hortonian Watershed Models for Steeply-Sloping Forested Watersheds: Application to Eastern Kentucky; 03, The Effect of Preozonation on the Anaerobic Biodegradability of Resistant Phenolic Compounds; 04, Predicting Potential Aluminum Contamination of Surface and Groundwaters from Acid Sulfate Enriched Drainages Eminating from Low Neutralization Capacity Watersheds; 05, Surface and Groundwater Contamination Potential from Three Triazine Corn Herbicides; 06, Teratogenic Effects of Aquatic Pollution on Embryos of Freshwater Fish and Amphibians. The Institute's information transfer activities are included along with the cooperative arrangements that exist with the Institute. The University Advisory Council for 1986 is listed. Training accomplishments for fiscal year 1986 research projects are given in terms of category and academic level. (Huffsey-U. KY WRRI)
W88-04738

FISCAL YEAR 1986 PROGRAM REPORT (NEVADA WATER RESOURCES CENTER).
Nevada Univ. System, Reno. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128095/AS. Price codes: A03 in paper copy, A01 in microfiche. Desert Research Institute, Program Report G1238-01, July 1987. 28 p. Contract No. 14-08-0001-G1238. Project No. USGS G1238-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Nevada, Conjunctive use, Groundwater quality, Salinity, Photosynthesis, Water reuse, Organic compounds, Physicochemical treatment, Water supply, Community development, Water demand, Leaching fractions, Water uptake.

Nevada's arid climate limits the available water supply, yet attracts increasing numbers of people. Over the past two decades, Nevada has had one of the highest growth rates in the nation. This increase in population has placed demands on existing water supplies as well as waste treatment facilities. Two projects addressed water availability: one was developed to optimize the usage of surface and groundwater in the Truckee Meadows area; and the second is investigating optimal water management and investment strategies for rural communities faced with risks in forecasting future municipal water demands. A third project is investigating an economical means of upgrading wastewater effluents for water reuse. Because agriculture is being forced to consider the possibility of utilizing poorer quality waters, knowledge of salt effects on crop plant water use and productivity is essential. Two research projects were developed to address salinity problems: one is studying the influence of varying leaching fractions, water quality and soil type on root distribution and fractional water uptake, while a second project investigated the salinity effects on photosynthetic CO2 fixation. A total of seven undergraduate and seven graduate level students participated in the 1986 program. (Cosens-Desert Res.Inst., NV U.)
W88-04739

FISCAL YEAR 1986 PROGRAM REPORT (NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE),
New Mexico Water Resources Research Inst., Las Cruces.
B. J. Creel.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128087/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G124-01, August 1987. 24 p. Contract No. 14-08-0001-G1241. Project No. USGS G124-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *New Mexico, Saline groundwater, Infiltration, Alfalfa, Plant physiology, Recharge.

The New Mexico Water Resources Research Institute's (WRRI) goal is to maintain a balanced research program to address critical state, regional and national water problems. Areas targeted as high priority for institute funding are: (1) water conservation, (2) surface-groundwater relationships, (3) water quality, and (4) saline groundwater management. The institute's USGS program supported two projects in the first area. 'Irrigation Management Procedures to Maximize Production of Alfalfa Populations Selected for Increased Performance Under Deficit Levels of Irrigation' aims to develop alfalfa strains that will maintain current yield levels with less water. 'A Physiological Route to Increased Water-Use Efficiency in Alfalfa' uses quantitative relations of two physiological traits to design breeding programs for alfalfa to achieve higher water use efficiency and forage yield. Area two is addressed by 'Field Study of Ephemeral Stream Infiltration and Recharge' which compares recharge computational methods and evaluates the importance of unsaturated flow on recharge from ephemeral streams. 'The Growth of Commercially Valuable Oysters in the Saline Groundwater of New Mexico' deals with area four by determining the feasibility of raising oysters commercially in areas of the southwest with a source of suitable saline groundwater. (Klett-NM WRRI)
W88-04740

FISCAL YEAR 1986 PROGRAM REPORT (WEST VIRGINIA WATER RESEARCH INSTITUTE),
West Virginia Univ., Morgantown. Water Research Inst.
C. R. Jenkins.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-128079/AS. Price codes: A03 in paper copy, A01 in microfiche. Fiscal Year 1986 Program Report G1260-01, June 1987. 34 p. Contract No. 14-08-0001-G-1260. Project No. USGS G1260-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *West Virginia, Bacteria, Water quality, Acid mine drainage, Geochemistry, Filtration, Septic tanks, Fish, Iron, Bioassay, Embryonic growth stage, Cattails, Wetlands, Fish survival, Fish behavior, Water pollution.

The West Virginia Water Research Institute program for 1986 was planned in collaboration with state and federal agencies. Seven research projects, one technology transfer project, and one data management project supported 19 students. G. K. Bissonnette investigated bacterial analysis of rural groundwater supplies. Background microorganisms frequently interfere with coliform detection leading to false negative results. J.J. Renton and A.H. Stiller completed a study on acid producing potential of various rock lithologies. Chemical reactivity and sulfur content are not synonymous. M. Usmen, W.A. Sack, and S.P. Dix investigated the use of bottom ash for filtration of septic tank effluent. Unscreened bottom ash is a satisfactory substitute for sand. E.C. Keller, Jr., and J.A. Marshall are modeling the effects of iron and associated chemistry on fish. When comparing biological indices at impacted and non-impacted sites species distribution and biomass were the same, but the condition factor was lower at impacted sites. R.C. Lantz and D.E. Hinton evaluated a fish-embryo bioassay of contaminated groundwater. Sensitivity was demonstrated but two species show wide disparity in observed effects. D.E. Samuel, J.C. Sencindiver, and H.W. Rauch are evaluating cattail marshes for controlling the quality of surface mine drainage. Cattails grow well but do not take up iron or manganese. Rodents populate the marshes and show increased iron. E.C. Keller, Jr., and J.A. Marshall studied the effects of iron on fish. Ferric iron causes respiratory cycles to develop. Iron and aluminum were not lethal to adult fish, but were to fry. E.C. Keller, Jr. organized a water research conference. A Proceedings will be published. J.A. Gidley and S.P. Dix worked on a data management project to develop a computerized data base containing bibliographic citations at WVU not available by conventional searches. (Jenkins-WV U.)
W88-04741

FISCAL YEAR 1986 PROGRAM REPORT (NEW JERSEY WATER INSTITUTE).
Rutgers Univ., New Brunswick, NJ. Div. of Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-104666/AS. Price codes: A03 in paper copy, A01 in microfiche. Center for Coastal and Environmental Studies, Program Report G-1240-01, July 1987, 25 p, 3 fig, 1 tab, 8 ref. Contract No. 14-08-0001-G-1240. Project No. USGS G1240-01.

Descriptors: *Water Research Institute, *New Jersey, *Research, *Training, *Information transfer, Acid rain, Aquatic soils, Arsenic, Bioindicators, Cadmium, Chlorinated hydrocarbons, Chromium, Copper, Dioxin, Environmental effects, Fish, Laboratory study, Lakes, Lead, Nickel, Pathology, Sedimentation, Stream water, Trace metals, Water pollution, Zinc.

The 1986 New Jersey Water Institute program focused on a key issue currently facing the state: contamination of surface waters by organic and inorganic substances. Four of the six funded projects assessed the behavior of trace metals in various surface water systems, including the Great Swamp, the Raritan River, Lakes Bay, an estuarine embayment, and Union Lake, a fresh water system in southern New Jersey. A fifth project investigated the response of early life stages of fish to sediment-associated dioxins. Another research effort addressed acidic deposition, with a focus on the role of the natural processes in mitigating the effects of acidic deposition on the New Jersey

Pinelands. Major information transfer activities included production of a Newsletter and an Annual Meeting. (McIntosh-Rutgers U.)
W88-04756

FISCAL YEAR 1986 PROGRAM REPORT (NEBRASKA WATER RESOURCES CENTER).
Nebraska Univ., Lincoln. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-104682/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1237, August 1987. 27 p. Contract No. 14-08-0001-G-1237. Project No. USGS G1237-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Nebraska, Soil properties, Infiltration, Precipitation, Groundwater recharge, Nitrate, Water treatment, Drinking water, Drought, Climatology, Crop yield, Soil conservation, Water conservation, Runoff, Water quality, Bacteria, Pollutants, Optimization, Model studies, Conjunctive use.

Water problems in Nebraska addressed by 1986 research program projects included: influence of soil type, tillage and precipitation patterns on groundwater recharge and surface water supplies; removal of nitrates from drinking water; impact of droughts; soil and water conservation; indicators for surface water pollution; and conjunctive management of surface and groundwater. Project 02 measured the runoff amounts and infiltration from rainfall on 3 soil types with different tillage practices. Project 03 examined the feasibility of using pickle liquor (a waste product from irrigation pipe manufacturing) to remove nitrates from drinking water. Project 04 is continuing to determine the influences of weather and drought on crop growth, development and yield, and to develop crop specific drought indices capable of assessing the impact of weather on crop production. Project 05 examined the effect of such interrow tillage techniques as subsoiling, basin tillage and depression storage on the water infiltration and runoff on sloping lands. Project 06 tested the use of the Bacteriodes fragilis group and their bacteriophages as indicators of human fecal pollution of surface waters. Project 07 used a mathematical simulation model to develop 'optimal' pumpage and recharge policies for the conjunctive management of surface and groundwater systems. (Powers-U. Nb, NWRC)
W88-04757

FISCAL YEAR 1986 PROGRAM REPORT (RHODE ISLAND WATER RESOURCES CENTER),
Rhode Island Univ., Kingston. Water Resources Center.
P.C. Poon.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-104690/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1250-01, July 1987. 31 p. Contract No. 14-08-0001-G1250. Project No. USGS G1250-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Rhode Island, Groundwater, Nitrate-nitrogen, Fertilizer, Leaching, Turf grasses, Surface water, Ice control, Salt, Sodium chloride, Gasoline, Model studies, Multiphase flow, Oil, Petroleum products, Water supply, Filtration, Coagulation, Flocculation.

By detailed partitioning of nitrogen in soil solution, turf clipping, and soil organic for various fertilizer rates, a better method of managing lawn turf to minimize nitrate contamination of groundwater was found. Extensive studies showed chloride concentration for river baseflows in Rhode Island lower than the current EPA standards and advisory limits. Both road density and the subsoil layer under the highway in swamp areas were found to affect the chloride concentration. A numerical model of two-phase (gasoline/groundwater) immiscible fluid flow through soil was developed to predict gasoline movement in aquifers and for optimizing the pumping rates in a clean-up process. Effects of alum coagulant dosage, mixing intensity, and mixing time on direct water filtration performance and its optimization in sand filters were investigated. Seminars, newsletters, and public information reports were the major activities of information transfer to address water resources problems and research activities in the State of Rhode Island. (Poon-RI U., WRRC)
W88-04758

FISCAL YEAR 1986 PROGRAM REPORT (ARIZONA WATER RESOURCES RESEARCH CENTER).
Arizona Water Resources Research Center, Tucson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-104674/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1211-01, July 1987, 41 p, 9 tab. Contract No. 14-08-0001-G1211. Project No. USGS G1211-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Arizona, Microbial degradation, Organic compounds, Risk assessment, Water conservation, Evapotranspiration, Irrigation, Technology, Conjunctive management, Upper Santa Cruz River Basin, Upper San Pedro River Basin.

The research projects supported by the 86 Program addressed the following critical water issues in Arizona: water quality (Projects 02, 07 and 09), agricultural water management (Project 03). Project 02 examined the conditions affecting biodegradation of phenol and chlorophenol in the subsurface. Project 07 comprised a risk analysis of potential groundwater contamination from agricultural, industrial (mining), and municipal sources in the Upper Santa Cruz Basin. The utility of chloride-bromide ratios in groundwater as indicators of water origin was determined during Project 09. Project 04 developed improved irrigation management criteria for turfgrass. Project 05 assessed the economics of alternative irrigation techniques. Project 06 developed a reference crop method for evaluating evapotranspiration in Arizona. Project 03 compiled and assessed technical and policy-related information for conjunctive management in the Upper San Pedro River Basin of Southern Arizona. The information transfer program was enhanced by a newly-created water information center which published newsletters and issue papers, and held workshops and conferences. (USGS)
W88-04765

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

NHIMS, NORTHWEST HYDROLOGIC INFORMATION MANAGEMENT SYSTEM, USER'S MANUAL,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W88-04745

10C. Secondary Publication And Distribution

WATER RESEARCH IN AUSTRALIA: CURRENT PROJECTS 1986.
Department of Resources and Energy, Canberra (Australia)
Australian Government Publishing Service, Canberra, 1987. 157 p. Edited by Pam Handyside and Janet Smith.

Descriptors: *Water resources research, *Water research, *Australia, Abstracts, Research priorities, Indexes.

This is an annual publication incorporating about 1000 summaries of water related research projects currently undertaken in Australia by individuals and research organizations. Research projects are grouped according to broad subject categories, and within these are listed in alphabetical order by project title. Two indexes allow retrieval by the names of members of the research team and the organizations carrying out or sponsoring the research, and by subject, using terms from the AQUALINE Thesaurus and additional Australian terms. Information included in the publication is taken from the Australian computerized data base, STREAMLINE. (Author's abstract)
W88-04724

PROCEEDINGS, SEVENTEENTH MISSISSIPPI WATER RESOURCES CONFERENCE, 25-26 MARCH 1987, JACKSON, MISSISSIPPI.
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 6B.
W88-04749

10F. Preparation Of Reviews

LITERATURE REVIEW OF THE EFFECTS OF PERSISTENT TOXIC SUBSTANCES ON GREAT LAKES BIOTA,
Beak Consultants Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 5C.
W88-04726

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GROUNDWATER POLLUTION

GROUNDWATER POLLUTION *COMPREHENSIVE EMERGENCY RESPONSE COMPENSATION AND LIABILITY ACT

GROUNDWATER POTENTIAL

GROUNDWATER QUALITY

GROUNDWATER RECESSION

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